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The Society is not responsible, as a body, for the facts and opinions advanced in the papers published by it. Editorials are by the Editor-in-Chief unless otherwise indicated and do not necessarily represent the opinion of the Society as a whole.

EDITORIAL

Public Relations

THE federal Forest Service has just been extensively reorganized. In the new scheme Public Relations, one of the primary branches ever since 1920, disappears from the chart. Instead, there is a "Division of Information, Publication, and Education."

Assurance is given that the change means no decrease of public relations importance. Whether the new label is as good as the old one may be a question; the two seem to have different implications. However, nomenclature is of minor concern. Not so the question what public relations should be in any public enterprise.

Many people eye equally askance "information," "education," and "public relations," as names of governmental administrative activities. All three are held suspect as covering activities designed to enhance bureau prestige and power, influence legislation, obtain mounting appropriations, and generally serve the bureau's special ends by building up favorable public opinion. In other words, all three are by some regarded as thinly camouflaged activities of propaganda.

Bureau aggrandizement through skillful propaganda, these critics would say, rivets on the country the evils of bureaucracy and defeats the popular will. The constitutional division of executive and legislative powers is held invaded if agencies whose business it is to execute the laws can sucessfully put pressure upon Congress; and the contemporary European scene shows how a regimented public opinion can become an instrumentality not only for exalting and centralizing executive power but also for the permanent fixing of that power in the hands of a group or a dictator.

But group pressure upon Congress is always with us. Special interests of all kinds apply it. And the same thing is true whenever a body of citizens undertakes to secure desirable or to block pernicious legislation, in the interest solely of the general welfare. Leadership of public opinion is essential to enable thought to crystallize and focus. The much decried power of the lobby, through which much of the pressure is applied, is not necessarily sinister. Legislative agents in Washington represent a multitude of causes, some private, some public. The Society of American Foresters, on occasion, presents the views of the profession to committees and individual members of Congress. The American Forestry Association exists primarily to educate and organize public opinion in the interest of sound public policies of forestry, and to make itself heard on concrete legislative proposals both through publicity and through direct legislative contacts.

A recent magazine article, entitled "In

Defense of Lobbying," points out quite truly that informed representation even of special interests by legislative agents concerned solely with protecting or advancing the cause of their clients helps legislators greatly in their task. Assuming for the moment that the prime purpose of a "Public Relations" unit in a governmental bureau is to build up an intelligent conception of the bureau's functions and objectives, make known what it is doing, and bring to its support as many agencies as possible when legislation affecting it is proposed, do activities of this kind deserve censure? How otherwise can group pressure in opposition to desirable public policies be offset? or the value of what is being done made manifest to Congress, a body whose members are always keenly sensitive to the currents of opinion?

All of which does not get us much beyond the point of concluding there is much to be said on both sides. It will help to get deeper down in the questions involved if the growth of "public relations" in private business be briefly considered.

That business has long been deeply in politics is a truism. It had to be. It could not flourish without a government favorable to business. It required laws that safeguarded and aided it, and it required to be let alone to pursue its normal course under these favorable laws. As the era of big business dawned after the Civil War, some forms of business required individual laws. With the spoils system in full flower, with a wild scramble for money-making on, and with ethical standards both in business and in politics debased, legislation and municipal franchises were almost openly bought; and corruption and boss rule threatened the overthrow of American democracy as boodle aldermen, rings, and Tweeds signalized the cankerous growth of the unholy alliance between the brokers of political power and captains of industry and finance.

One result was a public demand for a federal civil service cut loose from the political machines. In its inception the drive for civil service reform was not directly aimed at increasing the efficiency of the public service. That at most was a minor and incidental consideration. The primary aim was to make public administration independent of party control and of servitude to the interests of the party organizations, through which political favors were bestowed. The recent growth of the science and art of personnel administration has made clear that the merit system is not only a means of escape from the spoils system but also a basic prerequisite for business efficiency, —just as fire protection is a basic prerequisite for forestry. The earlier purpose was less ambitious. It sought merely to preserve American democracy.

But the boss-controlled political machines had other things to trade or sell besides appointments and influence in the field of administration. Not to speak of the courts, there was the rich field of legislation. And this could be worked both ways. For business not only needed laws favorable to business; it needed, given those laws, to be let alone. In other words, it could be squeezed. Conspicuously exposed were the railroads. In the end, it often proved cheaper to dominate legislatures than come to terms with the bosses and free lancers; and railroad-controlled legislatures came into vogue.

That great corporations tend to take on some of the characteristics of bureaucracies has been noted in a former editorial in the JOURNAL. This is the more true the more they gain a position of monopolistic advantage. Public service corporations were for a time highly indifferent to public opinion. The resulting unpopularity, however, proved costly. Something was needed which no legislative vote could confer—popular good will. To obtain it, the press agent was brought on the scene.

Very slowly, it has come to be recognized that the building up of good will calls for laying much deeper foundations, in the relations of the organization with the public wherever the organization comes in contact with the public. A grouchy freight agent, an unobliging station employee, or a discourteous conductor unfavorably affects the reputation of his company as an agency of service. Selling any enterprise, public or private, to the everyday citizen (selling, that is, in the sense of establishing the enterprise firmly in general esteem) requires, to be permanently successful, not resort to the arts of propaganda but a genuine spirit of service pervading the entire organization, from top to bottom, and finding appropriate and satisfactory expression in the way all things are done. This is public relations. To assure its constant functioning it must have organized direction.

Rightly applied in public administration, it is not a means of bulwarking bureaucracy, but an antidote to bureaucracy; for it accepts accountability to the public judgment as fundamental. It seeks not to defeat democracy through moulding and marshalling public opinion in its favor by the processes of propaganda, but to advance democracy by enabling the public to use more discriminately the tool of government.

Democracy may be defeated by the rule of physical force—army, blackshirt, vigilante, or mob; by the rule of money; or by regimented public opinion. The tremendous potency of indoctrination through propaganda is being demonstrated on a great scale today in other countries. It is being employed in our own country by many who seek to advance their own ends through its methods. In the business world it plays no insignificant role. It is heartening, however, to read the words of the presiding officer in summarizing the views of a conference of business management experts on public relations:

"These papers, though diversified, have revolved around the crystal of one thought. . . . They have emphasized the importance, both to the company and to the public, of *the truth* in regard to the activities, the product, the personnel, the organization, and the ideals of each company in this great industrial America."

Organized provision for right public relations, under whatever name, is essential both in governmental and in business administration. In both, the line must be firmly drawn between winning public confidence through deserving it and pursuing the false objective of victory through manufactured and manipulated public opinion. Further, right public relations in a governmental administrative agency require that neither the purposes nor the methods be political. The merit system rests on the cornerstone of divorcement of administration from political purposes. The provisions of the National Forest manual of administrative regulations and instructions are germane:

"It is axiomatic that National Forest administration must be kept out of politics. . . . National Forest administration . . . must also be kept free from the use of political methods to procure or influence legislation, federal or state, for its own ends. Whether these ends are selfish or disinterested is immaterial. . . . Resentment is certain to follow a public belief that the Service is a political machine, interfering with free government."

THE EFFECT OF THE MICHIGAN 15 MILL TAX LIMITATION ON FOREST PROPERTY AND COMMUNITIES

By P. A. HERBERT

Michigan State College

Forest land owners, by combining with other tax payers to limit the rate of taxation under the general property tax, reduced their taxes in Michigan $4,614,561, or 47 per cent annually, with the prospects as old bond issues are liquidated of reducing the burden 61 per cent. This is the first legislation to bring about immediate and substantial tax savings to all forest land owners.

SEVENTEEN years ago the Michigan legislature made its first gesture to encourage the practice of private forestry by tax reduction. It was the usual type of forest tax law—voluntary and limiting the assessed value to one dollar per acre, but requiring the payment of a small yield tax. Its failure to induce forestry practice was blamed in part on its limited application to farm woodlands. So the legislature in 1926 gesticulated again, with the approval of foresters, and enacted another voluntary law applying to all cut-over woodland; it limited the tax to 10 cents an acre, with a yield tax of 10 per cent. Still no one was enticed into the practice of forestry; although a few land owners did take advantage of that law, as they did of the former law, and classified their land under it, by no stretch of the imagination has either law led to private forestry practice.

The extent to which tax reduction can encourage forestry practice is, of course, open to serious question. As far as such inducement can be created by taxation, the forest land owner in Michigan now has had it offered to him, not by the special forest tax laws referred to above, nor indeed by any act of the duly elected representatives of the people, but by the irate tax-payers themselves, who by initiative amended the state constitution in 1933, thereby limiting the rate of taxation on all rural property to 15 mills, exclusive of taxes to liquidate previously authorized debts.

Under the constitutional amendment the taxes on rural property in the forest and mineral counties of Michigan were reduced 44 per cent, representing a saving of $4,614,561 in one year's tax bill! (Table 1). The largest reduction (47 per cent) took place in the forest counties of the Lower Peninsula, where no merchantable timber now remains in the once "inexhaustible pineries." Savings to the tax payers in the mineral counties, where the remnant of virgin timber is located, were almost as large ($1,816,817).

Even greater reductions would have resulted on the Upper Peninsula had it not been that in 14 townships, where resident tax payers own only a small fraction of the taxable property, these residents were able to secure the necessary two-thirds vote to increase the levy above 15 mills, the legal maximum as the result of such a vote being 50 mills in 4 years out of 5. This partly explains why the township tax levy on the Upper Peninsula was greater in 1933 than in 1932.

According to Table 2, in 1933 $1,869,084, or 31 per cent of the total rural tax burden in northern Michigan, was levied to pay for previously incurred debts which means that the tax bill eventually will be that much less because funds to

liquidate future debts must be raised under the 15 mill limit, whereas most of the payments on past indebtedness are being secured by a levy above the 15 mill limit. Thus, when all old obligations are liquidated, the tax levy, at present assessed values and the usual 15 mill maximum, will be $6,483,645, or 61 per cent less than the 1932 levy (reduction in Table 1 + indebtedness Table 2).

The assessed value should increase as the second growth timber increases in size and in value. However, predicted arbitrary increases in assessed value to offset the 15 mill limit have not occurred. Table 4 shows that the decrease in total assessed value in the northern townships in 1933 was $28,612,549, or 8 per cent below that in 1932. The largest decreases occurred in the Upper Peninsula counties. These decreases, and those yet to come, are justified because most forest land in Michigan is assessed at several times the price that the United States Forest Service has been paying for it. The assessor's values still reflect the era when every acre of cut-over land in the state was considered potential agricultural land.

This saving to forest land owners has naturally benefited the owner of both cut-over and timbered land. The 47 per cent reduction in taxes and 3 per cent reduction in assessed value in the forest counties of the Lower Peninsula (Tables 1 and 3) represent decreases in tax burden to the owner of cut-over land. Table , tabulated from data secured for 27 townships on the Upper Peninsula in which virgin timber stands still cover a large acreage, shows that the property of these owners has had a 36 per cent reduction in taxes with a 5 per cent decrease in assessed value. The larger reduction occurred in the forest counties of the Lower Peninsula because tax rates in 1932 averaged higher there than in the timbered townships, where naturally the tax base is greater.

TABLE 1

COMPARISON OF RURAL TAX LEVIES OF 1932 AND 1933 IN NORTHERN MICHIGAN

Tax	All counties in northern Michigan				Forest counties of Lower Peninsula[1]				Forest counties of Upper Peninsula[2]				Mineral counties of Upper Peninsula[3]			
	1932	1933	Decrease		1932	1933	Decrease		1932	1933	Decrease		1932	1933	Decrease	
levy	Amount	Amount	Amount	%	Amount	Amount	Amount	%	Amount	Amount	Amount	%	Amount	Amount	Amount	%
Total	10,602,762	5,988,201	4,614,561	44	3,931,619	2,080,346	1,851,273	47	2,578,010	1,631,537	946,473	37	4,093,134	2,276,317	1,816,817	44
State	1,218,667	200,819	1,017,848	84	626,166	107,452	518,714	83	206,554	34,991	171,563	83	385,947	58,375	327,572	85
County	2,426,901	1,657,152	769,749	32	534,688	318,457	216,231	40	817,884	590,211	227,673	28	1,074,329	748,484	325,845	30
Township	942,942	1,073,887	-130,945[4]	-14[4]	435,820	379,500	56,320	13	206,529	270,679	-64,148[4]	-31[4]	300,593	423,710	-123,117[4]	-41[4]
Roads	1,452,453	373,082	1,079,371	74	407,031	58,119	348,912	86	417,604	171,825	245,779	59	627,818	143,138	484,680	77
Schools	4,489,656	2,623,971	1,865,685	42	1,877,265	1,172,334	704,931	38	922,517	560,128	362,389	39	1,689,875	891,509	798,366	47
Misc.	72,143	59,290	12,853	18	50,649	44,484	6,165	12	6,922	3,705	3,217	46	14,572	11,101	3,471	24

[1] Counties north of Bay City and Muskegon line except Midland, Newaygo, and Oceana.
[2] Alger, Baraga, Chippewa, Delta, Luce, Mackinaw, Schoolcraft.
[3] Dickinson, Gogebic, Houghton, Iron, Keweenaw, Marquette.
[4] Increase.

TABLE 2

COMPARISON OF SEPARATE RURAL CURRENT LEVIES WITH DEBT SERVICE LEVIES, NORTHERN MICHIGAN TOWNSHIPS, 1933

Levy	Total	Current levy		Debt service levy	
		Amount	Per cent	Amount	Per cent
All	$5,988,201	$4,119,117	69	$1,869,084	31
State	200,819	200,819	100	0	0
County	1,657,152	1,124,166	68	532,986	32
Township	1,073,887	660,092	61	413,795	39
Roads	373,082	322,928	87	50,154	13
Schools	2,623,971	1,783,848	68	840,123	32
Misc.	59,290	27,264	46	32,026	54

TABLE 3

COMPARISON OF TOTAL RURAL CURRENT LEVY WITH DEBT SERVICE LEVY IN THE SEVERAL REGIONS OF NORTHERN MICHIGAN

Levy	Total	Current levy		Debt service levy	
		Amount	Per cent	Amount	Per cent
All northern counties	$5,988,201	$4,119,117	69	$1,869,084	31
Forest counties of lower peninsula	2,080,346	1,557,190	75	523,156	25
Forest counties of upper peninsula	1,631,537	1,000,176	61	631,361	39
Mineral counties	2,276,318	1,561,751	69	714,567	31

TABLE 4

RURAL ASSESSED VALUES OF 1932 AND 1933 IN THE NORTHERN TOWNSHIPS OF MICHIGAN

Region	Assessed value		
	Total	Real estate	Personal
All northern Michigan			
1932	$367,770,472	$324,926,193	$42,844,279
1933	339,157,923	299,131,751	40,026,172
Decrease—amount	28,612,549	25,794,442	2,818,107
Decrease—per cent	8	8	7
Forest counties of lower peninsula			
1932	$197,878,136	$181,701,461	$16,176,675
1933	192,374,538	176,063,285	16,311,253
Decrease—amount	5,503,598	5,638,176	134,578[1]
Decrease—per cent	3	3	1[1]
Forest counties of upper peninsula			
1932	$62,349,814	$56,243,118	$6,106,696
1933	55,849,956	50,287,204	5,562,752
Decrease—amount	6,499,858	5,955,914	543,944
Decrease—per cent	10	11	9
Mineral counties of upper peninsula			
1932	$107,542,522	$86,981,614	$20,560,908
1933	90,933,429	72,781,262	18,152,167
Decrease—amount	16,609,093	14,200,352	2,408,741
Decrease—per cent	15	16	12

[1]Increase.

A previous study[1] of typical cut-over townships showed that the maximum total tax per acre in 1932 was 29 cents, the minimum 5½ cents; whereas in 1933 the maximum was 14 cents and the minimum 4 cents, savings on individual properties ranging from 10 per cent to 64 per cent of the 1932 tax. Taxes on separate tracts of virgin northern hardwood timber varied considerably. Some descriptions had a tax burden of 55 cents an acre in 1932 as against 37 cents in 1932, whereas similar stands under other taxing jurisdictions were taxed at 32 cents per acre in 1932 and 20 cents in 1933. One of the few remaining northern hardwood stands on the Lower Peninsula bore a tax of $1.54 an acre in 1932 and 95 cents in 1933.

The evidence presented in the preceding paragraphs is exceedingly clear—taxes have been cut nearly in half on forest property in Michigan. So after years of futile efforts to enact special legislation, the forest land owner by uniting with all other tax payers has secured a very material reduction in his present tax burden, and that without the specter of a yield tax hanging over his head.

The voluntary special tax laws still remain on the statute books; indeed, the more recent act applying to all cut-over land was amended during the last session of the legislature, reducing the specific payments from 10 cents to 5 cents an acre on the plea that the 15 mill limitation reduced to that figure the taxes on much land not under the tax law. Even with this reduction to a 5 cent specific tax, land will not be listed under the act unless the assessed value is sufficiently above $3.33 an acre (the value at 15 mills to raise 5 cents in tax) to offset the 10 per cent yield tax and other restrictions placed upon the owner of listed property. The uncertainty of future assessed value as the timber grows in size may influence the owner to list his land under the special forest tax law before actual present tax costs would justify it. However, the constant changes made by the legislature in the special forest tax law indicate that the future burden even under that law cannot be predicted.

On the other hand, it is to the distinct advantage of farm owners now to list their woodlands under the woodlot tax law because, with the assessed value fixed at $1 an acre under that law and the rate at 15 mills maximum under the constitutional amendment, the maximum tax on an acre of farm woods would be only 1.5 cents per year with a 5 per cent yield tax added on commercial cuttings.

To those interested in the public financing of forest land communities, the data presented in this article are also of considerable interest. Thus, Table 4 shows that in forest land townships, as elsewhere, the real estate makes up the bulk of the tax base, $324,926,193 as compared with $42,844,279 in personal property, and that the reduction in assessed value for 1933 was slightly greater on real estate than on personal property. Indeed, in the forest counties of the Lower Peninsula, where the tax burden rests heaviest, more personal property appeared on the rolls in 1933 than 1932.

The next question which comes to mind naturally is: With a reduced assessed value and a fixed maximum tax rate that resulted in a 44 per cent reduction in taxes, where were the reductions absorbed? A study of Tables 1 and 6 will answer the question. Schools received the largest reduction in funds, from $4,489,656 to $2,623,971, a cut of 42 per cent. However, because they absorb such a large part of the total levies of these townships and as both the state and

[1]Herbert, P. A., Tax burden on forest land reduced. Quar. Bull. Mich. Agr. Exp. Sta., 17:3, 1935.

road levies took greater proportional cuts, 84 and 74 per cent, respectively, schools actually absorbed a greater part of the total tax levy in 1933 than 1932, 44 per cent as compared with 42 per cent. This did not hold true of the Upper Peninsula, particularly the mineral counties, where the tax base is large and taxes are not absorbed to such a large extent by the absolute necessities of education. In the mineral counties, for instance, only 39 per cent of the restricted 1933 levy went to schools, whereas in the forest counties of the Lower Peninsula they absorbed 56 per cent of that levy, being only able to absorb 38 per cent of the reduction in levy between 1932 and 1933 against a 47 per cent cut in the mineral counties.

The state, although only absorbing 11 per cent of the total raised in the townships, eliminated 84 per cent of its levy in 1933, and roads with 14 per cent eliminated 74 per cent of the taxes for that purpose in 1933. The state found additional revenues in the sales tax, and the roads were largely financed by the motor vehicle and gas taxes. Efforts to reduce and limit the motor vehicle and gas taxes by constitutional amendment, as was done with the property tax rate, were overwhelmingly defeated at the polls.

It is interesting to note that the unit of government considered by many students of public organizations to be the least necessary, the township, absorbed a greater portion of the total levy in 1933 than in 1932 in all groups, and on the Upper Peninsula actually absorbed more in 1933 than in 1932, a 41 per cent increase in the mineral counties and 31 per cent in the forest counties (Table 1). This increase can be attributed almost entirely to overdrafts for local relief, which were then listed as debt services on the tax rolls of 1933.

The necessity of setting up the debt service levy separately from the current

TABLE 5

COMPARISON OF TOWNSHIP ASSESSED VALUE AND TAX LEVY IN 1932 AND 1933 IN 27 SELECTED TIMBERED TOWNSHIPS ON THE UPPER PENINSULA OF MICHIGAN

	1932	1933	1932-1933	Difference in per cent
Assessed value	$37,263,225	$34,927,044	$2,336,181	5
Current tax levy	1,575,125.58	610,942.20	964,183.38	---
Debt service levy	00.00	381,575.92	-------	---
Total of all tax levies	1,575,125.58	1,005,807.32	569,318.26	36

TABLE 6

PERCENTAGE OF THE TOTAL TOWNSHIP TAX BURDEN OF THE COUNTIES IN NORTHERN MICHIGAN ABSORBED BY THE SEVERAL TAX LEVIES IN 1932 AND 1933

Levies	All northern counties 1932	1933	Forest counties of Lower Peninsula 1932	1933	Forest counties of Upper Peninsula 1932	1933	Mineral counties of Upper Peninsula 1932	1933
Total	100	100	100	100	100	100	100	100
State	11	3	16	5	8	2	10	3
County	23	28	14	15	32	36	26	33
Township	9	18	11	19	8	16	8	19
Road	14	6	10	3	16	11	15	6
School	42	44	47	56	36	35	41	39
Misc.	1	1	2	2	0	0	0	0

levy in 1933 makes it possible for the first time to analyze clearly the relationship between these two items. Where the non-resident owner pays the bulk of the taxes, namely in the Upper Peninsula, there the residents are most willing to vote improvements involving bond issues. Thirty-nine per cent of the total taxes collected there in the forest townships in 1933 was for the purpose of paying off debts; whereas in the forest townships of the Lower Peninsula 25 per cent was so absorbed. (Table 3). The schools, townships, and counties are the jurisdictions responsible for the major part of the debt service levied in the townships of northern Michigan (Table 2).

It is probable that the 15 mill limit will at times be found too low to permit all necessary capital investments, and that taxing jurisdictions will be able to secure the necessary two-thirds vote to raise the rate above 15 mills to the legal maximum of 50 mills to pay off such debts. When the debt is justified to maintain adequate public service, the forest owner has no reasonable recourse from excessive taxation except in so far as the state and other larger taxing jurisdictions can be prevailed upon to assume part or all of the burden. However, unreasonable capital investments can largely be avoided if the forest land owner operates his property to the obvious benefit and advantage of the local resident. Residents regularly employed by a forest business will be loath to vote bond issues which may destroy their source of livelihood.

PERTINENT OPINIONS OF FORESTRY PROBLEMS

By R. J. HOYLE

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IN THE August 1935 issue of the JOURNAL OF FORESTRY I published an article, "The Stumbling Block of Forestry," and following it was a rejoinder by Mr. William N. Sparhawk. While I did learn that there was to be a rejoinder, I did not see it until it appeared in print. I was glad to see it, for the original idea was to promote discussion on important and controversial points in the profession. After reading the rejoinder I decided to let the matter drop; but in view of the interest in the subject, as evidenced by recent articles and letters in the JOURNAL and particularly because of many letters I have received, it seems appropriate that additional light be thrown on this subject. This expression of interest is coming from foresters and timber owners, not only east of the Mississippi River but also from the West Coast. This article therefore represents the opinions of several. While a reply will not be made to all of Mr. Sparhawk's article, attention will be focused on a few pertinent points which seem most important. As in the previous article, this one is likewise written to stimulate constructive thought and discussion.

During the past year the departmental location of the Forest Service has been at stake through proposed changes in government "set-up." This has been of great interest to our profession. It is apparent to some that the future of the profession is also at stake, not through the transfer of the Forest Service alone but primarily through excessively large land acquisition and its train of probable evils.

Mr. Sparhawk says that I apparently "see the trees but not the forest." It is a compliment to be considered out in the woods. Generally, the men up in front and out on the rim of things are those who know the situation. Too much forestry and forest policy are being practiced in the office. Those who are in the field and really know must be amused, if their indignation does not get the better of them. Let us go out into the woods and stay there until we again know what the situation really is. Let us foresters invest just a part of our capital in timber or forest land, as evidence of our belief in forestry, for a few years and see if we will not then have a different understanding of the forestry problems.

He also says the "argument is based entirely on forestry for commodity production, and ignores completely the multiple functions and services which make forest conservation so much a matter of public concern." Any forester, unless he is twenty years behind the times, knows of the many forest values and recognizes their importance regardless of what names may be applied to them. My article may seem to have been based solely on commodity production, but a short article must be confined to some specific points. Government ownership was advocated for certain purposes other than production, but space did not permit of dwelling upon this subject. A point which often seems to be forgotten is that private forestry has always given and is still giving this "multi-purpose-forestry," and will give it a great deal more in nearly every case, and much cheaper, than public ownership if the public interest and activity is focused on making private forestry profitable.

Mr. Sparhawk says I feel that the large government forestry program "probably will become enmeshed in politics" and also that I express "doubt as to whether

the bogey-man may not sooner or later capture the Forest Service." The interpretation was correct on these points, for that is exactly what was meant when the article was written in February, 1935 (it was not published until August, 1935). In view of what appears to have been happening in the past few months, one does not need to have his ear very close to the receiver to be convinced that this very condition, deplorable as it is, is rapidly developing.

A letter recently received from an outstanding forester on the West Coast is in part as follows: "Without question politics are entering more and more into the Forest Service policies. The old idea of service to the nation and technical integrity is disappearing, to the sorrow of hundreds of sincere government foresters. Instead we see compromise with political appointments; supervisors compelled to give more time to public relations than to management of their forests; and regional foresters given associates to attend to the details of administration so they may devote more time to politics and social planning." Not only does it appear that politics has crept into the Forest Service, but it is common talk among many foresters and others that in the past few months it has been entering the C.C.C. camps. Not only is the Forest Service at stake, but the profession itself seems to be getting into a political tangle from which it may never completely recover.

Another angle of this politics and the bogey-man may not have reached the attention of most foresters, so it seems fitting to include it here. A lumber trade journal editorial in discussing the Guffey Act recently said: "What has all this got to do with the lumber industry? The plain and sufficient answer is that there is not the thickness of one sheet of tissue paper between the implications and actual meanings of the Guffey coal mining measure and what some of the more prominent bureaucrats of Washington, D. C., would like to apply to the wide-flung lumber and timber industry, and this has been the case for years. Note some of the recent public comments of the Chief Forester of the United States in connection. For years the bureaus have looked with covetous eyes not only upon the coal industry but upon lumbering as well. The two industries are not only analogous but the likeness between them close.

"The understudies of such authorities as the Tugwells, the Wallaces, and the Ickeses are fairly itching to lay impertinent and incompetent hands on what they consider this very fat morsel in the country's business and economic setup. . . . For it is a fact that some of the eminent bureaucrats of Washington are now so obsessed and far gone with the idea that already they are at loggerheads with each other over whose department the plum shall fall into—and the records prove it! That gives the whole bureaucratic, socialistic idea entirely away, if one will but reason it out definitely to the end. . . .

"The bureaucrats are so perfectly infatuated as they view themselves from the heights of their self-esteem that they will undertake anything at any cost—provided only that the bill is sent to somebody else." If space permitted, other government activities which trend along this same direction could be cited.

Am I unduly alarmed? Perhaps I am. To one who has tried to follow and understand some of the public activities, the following quotation from the press seems fitting. "We are willing, as a matter of courtesy, to believe anything the administration says. We are willing to have faith in the professions and promises of the administration, but our faith is according to the definition of the small boy who said: 'Faith is believing what you know ain't so'." Some of us may not wish to subscribe to this quotation in full, but it shows that faith may be governed by actions.

Mr. Sparhawk says I admit that the Forest Service has done a splendid job. In the next sentence he says, "Can as much be said for forest enterprise?" An attempt was made to give full credit for the past splendid performance of the Forest Service, but at this point the views of others may be of interest. There are so many enlightening letters on this point that only a few can be used. A large timber owner in the South who has been active in the Lumber Code work and the establishment and administration of Article X writes: "The vital point which the Forest Department has overlooked, in my opinion, is that the practice of forestry and of growing timber has never been tried on any large scale in America, because it has always been economically impossible." He then strengthens this statement with an enlightening discussion on the tax situation and the fire problem, and continues it with the following: "If the professional foresters of the U. S. A. had devoted one-tenth as much energy toward solving the tax and fire problems as they have toward establishing government ownership, I am sure that we would now see a substantial part of our southern forest lands set aside for forestry preserves in the hands of private owners, which would make a success of it, yet the foresters seem to overlook that these two problems have to be met, as applying to such lands as the government may acquire."

A well known forester with wide experience throughout the East and particularly the South writes: "I agree with your point of view most heartily; you have brought out points that most foresters, not on public payroll, realize. I doubt if any prominent forester not on the public payroll could have been found to take the other side of the case. . . .

"I believe in government acquisition of land within reasonable limits, but only for purposes of demonstration and research. I can see the logic of having one or two National Forests of reasonable size in each important timber producing state. Average or below average land should be selected, however, and not the best.

"My principal objection to having the government as a competitor in forestry projects is that it is not fair competition. The private operator must pay for his mistakes and can't stay in business unless he is efficient, whereas bad management can continue indefinitely on National Forests and the small stockholders, namely the taxpayers, stand the bill, but do not have any way to stop it. In fact, 99.9 per cent of them don't have any way of finding out what kind of management they have on the job.

"It is only human nature for a man who is sure of his job to let down and coast along to a certain extent. He will do this without realizing it, no matter how sincere and conscientious he may be. This is the reason that Forest Service men cannot be expected to be as efficient as private foresters. They do not have the same incentive and do not have to render so strict an accounting of their stewardship at short intervals as is the case in private life. Without knowing it, they are bound to lose step with the realities of life.

"I cannot quote facts and figures to show that the National Forests in Florida are not managed as efficiently as are private forests of similar size, but from casual observation I am sure that such is the case. They employ more men, pay higher wages for similar work, and do a great deal of unessential work from which little if any revenue or benefit can be obtained either directly or indirectly."

A forester with wide practical experience on the West Coast writes: "Your article certainly raises many pertinent questions which are very close to those of us working in the field of private forestry. We have to *sell* forestry to the lumberman. He is not prosperous enough to

afford any luxuries. Yet economic conditions do not permit us to honestly tell him in most instances that he can practice sustained yield at a profit. Nor does the general Forest Service practice reassure him as to economical management. He sees much inefficiency and waste in their management of government lands, and knows that cost is not regulated by the value of the forest crop. It is far too easy to excuse high and unjustified costs by calling it 'experimental,' for the creation of 'social values,' or for the improvement of 'multiple use values.' All good, high-minded objectives, but they cover a multitude of economic sins."

If one needs further evidence or enlightenment, it can be found in recent issues of the JOURNAL and by men whose judgment stands at the top in the profession. Men who spend much of their time in the field usually know their facts.

Another quotation from Mr. Sparhawk's rejoinder is as follows: "For the government to attempt to promote the use of wood by discouraging the use of other materials would be a species of meddling in business which would rightfully be resented by the producers of such materials. They are just as much entitled to public assistance in maintaining and expanding their markets as are the producers of timber. It is not a proper function of government to play favorites by helping one branch of national economy at the expense of others." Let us look at this last sentence first. Is there not plenty of evidence to show that this is exactly what has been happening in our government in recent years? It is too well known to need further elaboration here. That is precisely one of the ills. Nearly everyone seems to be getting help except the timber owner. Strangely enough, foresters have seemed to hold themselves aloof and have not assumed their responsibility in helping the industry upon whom they depend for existence. The profession is just as much concerned as the industry, but not quite so directly. Perhaps foresters do not care whether industry fails, thinking that the government will eventually own all of the timber and that they can find employment with Uncle Sam. Everyone cannot work for the government. There is a limit to how far this trend can go.

A letter from a forester in the Northeast who is a large timber owner and operator, and who practices sustained yield management in a highly satisfactory way, reads: "Since the forest industries have never been subsidized as have many of those employing much less labor, and since they have never been given any assistance other than in any experimental way or forest fire prevention, it leads me to sincerely believe that the government, instead of offering remedial measures such as the A.A.A. in the case of the farmers, is out to extend the public domain to such an extent that the people will no longer own the land. Then we will have socialization. Who is going to pay the cost of handling these proposed enormous land purchases and their maintenance? The question has many sides, but can it be solved by a group who for the most part have never tried to handle lands and pay taxes, interest, and insurance? My view, I know, is utterly lacking in technical phrases, but they are so often used to cover up an almost complete ignorance of the earthly." Here is one of the few foresters who has had the courage to go into this forestry business with his training and capital. He is like most Americans, long-suffering and patient and says very little, but one can well believe that he knows what he is talking about.

Returning to Mr. Sparkhawk's statement regarding the promotion of wood by discouraging the use of other materials, etc. I have never said or even wanted to infer that the government should discourage the use of other materials. He also alludes to this activity as government med-

dling in business which should be resented by industry. Again we need go no further than the present government activities to find meddling and reason for resentment. At the bottom of page 1356 of the Copeland report, is the following statement by a competent writer: "In future plans for forestry, persistent effort must be put forth to retain, to recapture, and to expand the market for forest products, which means the use of modern competitive methods that have come into play in the development of other materials, nor is the motive solely one of profits to particular forest-using industries."

The subject of land acquisition and regulation has been discussed in many of these letters, and the general tone is about the same in all of them so only a few will be used. One says: "We have sustained yield and selective cutting. Naturally we should resent having the government buy up timbered lands near our mill and start up in competition with us, and are opposed to any government policy which seeks to control the lumber industry in this manner. We feel that the desired end of stabilization and conservation in our industry can be attained through coordination and regulation of the private companies now operating." This quotation and the following one are from the South. "For years we have practiced selective cutting and have held to the dream that in the end it will be profitable, even in the face of the prohibitive taxes, which we have always felt would be reduced." He continued: "We know that the Forestry Department will, out of necessity, be competing with us on a large scale before another generation has passed. If they are not actively in the business of cutting logs into lumber, they will be selling standing timber or logs to manufacturers, and most certainly a lot of these sales will be at prices with which the private owners cannot compete."

Summarizing another letter from the South, it would be as follows: The federal government's forest land acquisition policy and objectives are not clearly stated. These can only be surmised, and it is natural that they cause apprehension. It continues: "If forestry had been regulated and the lumber industry placed on a sustained yield basis from the very beginning, there would now be no occasion for a large land acquisition program, assuming that the government's principal objective is the perpetuation of the forests." In addition, he says: "Help in the solution of some of the most burdensome and irritating problems of these industries might reasonably result in making it unnecessary for the government to engage in some of the activities it has undertaken. But such help need not be expected if the real objective is not to foster private industry, but rather to socialize forests and other natural resources."

Another letter, from a timber owner in the Northeast who has selectively cut his lands for years, says: "The government has bought up several thousand acres right around our mill. We have a plant investment of $35,000 and employ steadily about 40 men, and now the government is buying up our timberland and paying exorbitant prices for it. Naturally, this does not make us very happy."

A forestry educator in the South who is primarily a silviculturist, and who has recently traveled through several Southern states studying private as well as public forests, writes the following: "I am heartily in sympathy with your point of view that the U. S. Forest Service could do much more than it has in stimulating private interest. As a matter of fact, I know that there are some men in the Service, especially in the Southern region who are not in sympathy with the present extensive land acquisition program of the Service."

In fairness to all, it should be said that several letters indicate that the problems vary greatly in sections of the country

and even between states in the same region. Many writers of these letters seem to feel that public acquisition is desirable only on types of land that are the least profitable for industry to hold. With this the writer concurs. Some writers have indicated that there may be some timberland owners who favor this large scale acquisition but, if they do, it is probably because they are unloading or hope to unload a lot of cut over lands to the government at excessive prices. A point that is commonly discussed in two forest regions, at least, is that prices two and three times greater than the market value are being offered for land by certain government agencies, all of which indicates vagueness, lack of coordination, waste, and the resulting fear of uncertainty on the part of the industry. Additional information is rendered on this point by another timberland owner who says: "Men who have invested all of their talents and money in the lumber business will be getting a ———— Deal when the government steps in and purchases the raw materials upon which they expect to continue to operate the plants in which their money is invested. Money to run this government must come from taxes, but if the source of taxes is destroyed, where will the money come from? Of course it might be said that other industries could carry the load, but what assurance have we that the same senseless . . . . plans for social control of forestry would not be extended to all industries?"

In the last paragraph of "The Rejoinder" is this statement: "The time has not yet come, nor is it likely to come, for us to slacken our efforts toward bringing about more efficient timber production and to concentrate them on utilization and marketing." It is easy to misinterpret, but I did not wish to convey an impression that there be any slackening of efforts toward production. What I did want to convey was that there should be an expansion of technical and market research and thereby secure a better balance between growth and markets for wood. From the general tone of the reply, I feel justified in again emphasizing this point.

In closing, a word of warning should be sounded to those foresters who believe in our form of American government and who want to protect and help our profession and private forestry. While public forestry is very desirable and has its place, private forestry seems to offer the broadest field for sound professional development. Extreme views have been freely expressed by those in public employ. These views should, however, be carefully considered with a fair and open mind. Those who know the situation, but generally say little, should have the honest and sincere conviction of expressing and re-expressing their ideas in an effort to clarify the situation. One group that has stood at the cross-roads has been looking down one road for a long time. Now, however, it is in a high powered "extreme line" car and going down that road at excessive speed. Will the other group at the cross-roads thoughtlessly follow along, or will it attempt to hold in check and correct a threatening situation? Before this decision is made, considerable discussion of many important points is desirable. Let us keep this discussion alive until it can reach some definite practical conclusions of value. The young forestry profession must go through these periods of growing pains. If judgment and cooperation are forthcoming, the results will be beneficial.

Perhaps some readers will feel that this whole problem is becoming more involved, and that they do not feel they really understand what the true situation is. If this is correct, possibly committees or groups may eventually clarify the situation; but the various expressions of thought should be very helpful to any group. There surely should be some diamonds among the rocks, even though they may be only in the rough.

FORESTRY, THE CINDERELLA OF AGRICULTURAL COLLEGES

By H. H. CHAPMAN[1]

A study of professional education in forestry was undertaken in 1934 by the Council in order to fulfill the mandate of the Constitution that a list of schools of forestry be approved by them, the graduates of which will be accepted as Junior Members of the Society without further evidence of their educational training. The approved list of schools appears in S.A.F. Affairs for December. Certain definite conclusions were drawn from this study, with respect to the position of departments of forestry located in state agricultural colleges, which are set forth in this article, the publication of which has the approval of the Council.

THE education of students for professional careers in forestry is undertaken in 24 institutions in the United States. Of these 2 are private (namely Yale and Harvard), a third, Duke University, will begin instruction in 1935-36. Of the 22 public institutions giving professional instruction in forestry, the universities of Idaho, Michigan, Montana, Oregon, and Washington have established separate schools of forestry,[2] while at Syracuse, New York, there is a state college of forestry under a separate board of regents.

At Cornell the forestry department will be on a postgraduate basis in 1936-37. At Minnesota forestry is one of three divisions of the College of Agriculture, Forestry, and Home Economics. At Washington State College it is a 3-year course, not giving a degree in forestry. In Utah it is a part of the "Schools of Agriculture and Forestry," and a separate school may there be contemplated but it is not yet achieved. The residual 12 institutions classify forestry as a department or as a curriculum under the School of Agriculture.

The registration in the forestry courses of the 15 institutions, excluding Cornell, which are incorporated as a part of agriculture totalled, in 1934-35, 2403 students out of 4027 registered in technical forestry and allied courses in the 24 institutions named. This is 59.67 per cent of the whole body of students. At New York State College of Forestry 459 students, or 11.60 per cent, were enrolled. Forty-three students, or 1.07 per cent, were taking postgraduate courses at Yale and Harvard. Cornell had 42 students, or 1.04 per cent, leaving 1072, or 26.62 per cent, in attendance at the universities of Idaho, Michigan, Montana, Oregon, and Washington, and a total of 40.33 per cent in institutions not a part of an agricultural college.

Of the total of 5803 graduates of these institutions, the 8 independent colleges account for 3150, or 54.28 per cent. The average age of these 8 colleges is 28 years, while for the departments in the 16 agricultural colleges it is 23.5 years. Thus the increase in forestry enrollment in 15 of these colleges has already changed the proportion from 45.72 per cent of existing graduates to 59.67 per cent of 1934-35 enrollment, or an increase of 30.51 per cent over the present proportion. The future standards of training in professional forestry will therefor be profoundly affected by the conditions existing at these 15 institutions.

An exhaustive study of the 24 schools of forestry, recently completed by the Society of American Foresters, shows that

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[2]The Department of Forestry at the University of Georgia was made a separate College in the fall of 1935.

ut of 14 schools accepted by the Council l 8 of the independent schools fall in is class, and but 6 of the remaining 16, aving 10 schools, or nearly two-thirds f the number, to fall into the subnormal assification. These 10 subnormal schools ccount for 1281 students, or 31.81 per ent of the total enrollment in forestry.

Of the 6 schools in the agricultural colges which are accepted, one, the Uniersity of California, is among the first . The other 3 are Yale, New York State, nd the University of Michigan, all independent schools.

Of the 5 remaining schools in agricultural colleges which fall in the accepted lass, Cornell, first established in 1898 nd discontinued in 1903 through the ilure of the Agricultural College to exend its support at a time when funds ere withdrawn by the legislature, was eestablished in 1910. Again in 1935 upport was withdrawn for undergraduate nstruction, placing the institution on a ostgraduate basis. The independent institution at Syracuse has succeeded to the unction of undergraduate training for he state.

The school at Minnesota is handicapped y lack of suitable building and floor pace and by a heavy teaching load. With 2.46 per cent of the attendance at the ollege, the floor space for forestry is but .48 per cent of the total agricultural lant. Of the total faculty forestry has .56 per cent, and of the budget 4.09 per ent. An adequate building has been romised for several years and there are ill hopes of obtaining it, since all of he other departments in agriculture are ow adequately accommodated.

At Pennsylvania State College, the reusal of the agricultural college authorities to establish a school in 1903 led Dr. . T. Rothrock to secure from the state a orest academy at Mont Alto which is ccredited with 209 graduates in forestry not included above). Then in 1906 a school was established at State College, and after much vacillation during three successive state administrations, the forest academy was merged with this school. The state had built a large plant at Mont Alto for the Academy, but at State College, in spite of a large building program, the School of Forestry is still housed in the dilapidated wooden structure which it first occupied. The attendance totals 35.30 per cent of the College, while the floor space is but 2.66 per cent. The faculty of forestry is 6.42 per cent and the budget 8.17 per cent of that for the College of Agriculture.

Michigan State College has provided an adequate modern building for forestry. Here the attendance is 36.15 per cent of that of the college, the faculty is 11.77 per cent, and the total budget is 8.26 per cent.

At Iowa State College the department is still classified as a part of the Department of Horticulture. The attendance is 19.31 per cent of the College, the faculty 6.58 per cent, and the budget 4.85 per cent, while the floor space for forestry is 4.01 per cent.

In spite of these handicaps, these 5 schools have been able to maintain standards which give them an accepted rank. With the remaining 10 schools these handicaps of inadequate space and equipment, insufficient faculty, heavy teaching loads, and lack of financial support are still further accentuated and these schools cannot now be accepted by the Society as giving instruction adequate for professional junior membership on the basis of the degree alone.

The averages for various factors which have been analyzed in the above special study in agricultural colleges are shown in Table 1.

There was a large influx of students into forestry courses during the year 1934-35 (and a still greater influx in 1935-36). The 1934-35 increase amounted for all

TABLE 1

COMPARATIVE DATA SHOWING ENROLLMENT, FACULTY, BUDGETS AND FLOOR SPACE DEVOTED TO AGRICULTURE AND FORESTRY RESPECTIVELY, IN 15 OF THE 16 AGRICULTURAL COLLEGES GIVING PROFESSIONAL INSTRUCTION IN FORESTRY
1934-35

Item	Total	Agriculture	Forestry	Average per school Agriculture	Average per school Forestry	Per cent for individual schools Agriculture	Per cent for individual schools Forestry	Ratio, agriculture to forestry
Enrollment								
15 schools[1]	7,183	4,790	2,393	319	160	66.88	33.82	2 : 1
5 schools[2]	3,767	2,627	1,140	525	228	69.74	30.26	2.3 : 1
10 schools[3]	3,416	2,163	1,253	216	125	63.82	36.68	1.73 : 1
Faculty								
15 schools	789.75	719	70.75	48	4.72	91.04	8 96	10.16 : 1
5 schools	458	420	38	84	7.6	91.70	8.30	11.05 : 1
10 schools	331.75	299	32.75	30	3.28	90.13	9.87	9.13 : 1
Budget, faculty salaries								
15 schools	$2,124,053	$2,912,707	$211,346	$127,514	$14,090	90 05	9.95	9.05 : 1
5 schools	1,504,732	1,378,793	125,939	275,759	25,188	91 63	8.37	10.95 : 1
10 schools	619,321	533,914	85,407	53,391	8,541	86.21	13.79	6.25 : 1
Budget, total								
15 schools	5,281,303	4,979,278	302,045	331,952	20,136	94.28	5.72	16.48 : 1
5 schools	3,939,085	3,725,941	213,204	745,188	42,641	94.59	5.41	15.37 : 1
9 schools[4]	1,342,218	1,253,337	88,841	139,260	9,871	93.38	6 62	14.11 : 1
Floor space, sq. ft.								
11 schools[5]	1,732,095	1,677,339	54,756	152,485	4,978	96.84	3.16	30.65 : 1

NOTE: It will be noted that the *relative* position of forestry in the 10 schools not accepted is better than that in the 5 accepted schools, hence these latter schools were accepted, not on this basis but (partly) on the actual totals as shown under averages, which enabled these schools to qualify.

[1]Cornell omitted throughout.
[2]Accepted by the Society.
[3]Not accepted by the Society.
[4]No data for one school.
[5]The nine schools and Minnesota and Penn State College (at State College only).

chools to a little over 50 per cent of the verage enrollment of the 5 preceding ears. If it continues for another 2 years, will double the attendance at schools of orestry. The ratios for attendance, aculty, budget, and floor space are comuted on the attendance as of 1934-35. he ratios which affect efficiency, namely hose for faculty, budget, and floor space, re seen to vary from 5.72 to 30.65 on a asis of 1 for forestry, as against a present attendance ratio of 2 to 1. Even after eduction of attendance to the level of the ears preceding 1934-35, these ratios ould be diminished by only one-third. he conclusion is that for the schools ocated in agricultural colleges, the plant rovided and the faculty are markedly ut of line with those provided in the ame institution for agriculture. When this fact is added a condition of financial weakness in the institution itself, acompanied by excessive increase in atendance in forestry courses, the conditions practically preclude the possibility of efficient instruction in professional forestry.

These conditions have arisen largely as the result of the historical development of the agricultural colleges and of their forestry departments. Based on a federal statute, aid has been given for many decades to these institutions both for teaching agriculture and for the research work of agricultural experiment stations. Attendance in agriculture was stimulated by legislation creating the agricultural extension service, and by our increasing agricultural prosperity. With the slowing down of these new demands for trained agricultural specialists, and the recession in agriculture, attendance at agricultural colleges fell off, while at the same time forestry enrollment increased. Many of these colleges, such as Minnesota, published but one list of students thus balancing the loss in agricultural enrollment by the gain in forestry.

Table 2

STATUS OF FORESTRY DEPARTMENTS IN 15 AGRICULTURAL COLLEGES
1934-35

	Enrollment						Faculty					
	Total, agriculture and forestry	Agriculture	Per cent of total	Forestry	Per cent of total	Agriculture, ratio to forestry	Total, agriculture and forestry	Agriculture	Per cent of total	Forestry	Per cent of total	Agriculture, ratio to forestry
alifornia	548	370	32.48	178	32.48	2.08	116	108	93.10	8	6.90	13.49
olorado	433	200	46.19	232	53.81	.86	23	17.5	76.09	5.5	23.91	3.18
onnecticut	100	80	80.00	20	20.00	4.00	26.25	25	94.33	1 25	5.67	16.64
eorgia	350	203	58.00	147	42.00	1.38	33	29	87.88	4	12.12	7.25
wa	974	786	80.69	188	19.31	4.18	76	71	93.42	5	6.58	14 20
ouisiana	408	318	77.94	90	22.06	3.53	29.5	26	88.14	3.5	11.86	7.43
aine	371	260	70.08	111	29.92	2.34	40	36	90 00	4	10.00	9.00
ich. State	520	332	63.85	188	36.15	1.77	51	45	88.23	6	11.77	7.50
innesota	875	581	67.54	284	32.46	2.08	126	119	94.44	7	5.56	16.99
ew Hampshire	151	113	74.83	38	25.17	2.97	34	32	94 12	2	5.88	16.01
. Carolina	310	160	51.61	150	48.39	1.07	61	58	95.08	3	4.92	19.32
enn State	847	548	64.70	299	35.30	1.83	89	77	86.52	12	13.48	6.42
rdue	396	302	76.26	94	23.74	3.21	43 67	40	91.59	3.67	8.41	18.91
ah	553	263	47.56	290	52.44	.91	12.33	8.5	68.94	3.83	21.06	2.22
ash. State	347	264	76.08	83	23.92	3.18	29	27	93.10	2	6.90	13.49
Total	7,183	4,790		2,393			789.75	719		70.75		
15 schools			66.86		33.14	2.36			89.00		11 00	8.09
Weighted			66.69		33 32	2.00			91.04		8.96	10.16

Meanwhile large numbers of departments had been established in agricultural colleges, each with its staff of professors, instructors, and research men, of which can be mentioned agricultural economics and farm management, agronomy, animal husbandry, dairy husbandry, horticulture, poultry husbandry, veterinary medicine, agricultural engineering, entomology. pathology, agricultural education, home economics, landscape architecture, farm crops, soils, bacteriology, biological and agricultural chemistry, botany, plant breeding, apiculture, fur farming, game breeding, and agricultural journalism. The number of these departments in the various colleges varied from 8 to 17. Forestry, except in Minnesota and Utah, was listed as one of these departments, on an equal footing with the others, or as a branch of some other department, as in Iowa. A second factor working against the proper recognition of forestry in these colleges was the general agricultural conception that the importance of forestry could be gauged by the place of the farm woodlot in farm economy, and that beyond this, forestry as a public program constituted a threat to agriculture by offering an alternative and less valuable use of soil.

The colleges have all pretty well outgrown these restricted economic conceptions and are increasingly recognizing the role of forestry as a balancing factor in land use. But this new orientation still has to overcome the double hazard of insufficient revenues and of a more equitable division of existing burdens of teaching and a more adequate plant for forestry. The conception that forestry, far from being a department of agriculture, is a coexistent field, having its own diversified problems of economics, engineering, silviculture, protection (including entomology and pathology), soils, management, utilization, and products, is recognized reluctantly by these older departmental heads, who far outnumber the forestry faculty with its one departmental vote. Nevertheless, an institution as a whole cannot suffer one-third of its graduates to go out inadequately equipped for their profession without itself incurring the stigma of inefficiency. The responsibility rests upon these colleges to

Table 3

STATUS OF FORESTRY DEPARTMENTS IN 11 AGRICULTURAL COLLEGES
1934-35

	Floor space, square feet					
	Total agriculture and forestry	Agriculture	Per cent of total	Forestry	Per cent of total	Ratio agriculture and forestry
Colorado	111,768	106,765	95.52	5,003	4.48	21.32
Connecticut	61,000	59,050	97.54	1,950	2.46	39.65
Georgia	128,587	121,537	94.52	7,050	5.48	17.24
Iowa	152,000	145,094	95.99	6,906	4.01	23.93
Louisiana	18,600	15,540	83.55	3,060	16.45	5.08
Maine	42,000	40,202	95.72	1,798	4.28	22.36
Minnesota	590,126	581,400	98.52	8,726	1.48	56.56
New Hampshire	100,000	98,500	98.50	1,500	1.50	65.67
North Carolina	166,000	160.800	96.87	5,200	3.13	30.95
Penn State	337,014	328,066	97.34	8,948	2.66	36.59
Utah	25,000	20,385	81.54	4,615	18.46	4.42
Total	1,732,095	1,677,339		54,756		
11 colleges			94.03		5.97	21.58
Weighted			96.84		3.16	30.65

ake active steps to alleviate this situation. These should be, first, adequate building space and equipment; second, restriction of enrollment by raising standards of entrance in forestry; third, more adequate provisions for the teaching staff as to numbers, salaries, and opportunities for research and study; fourth, better libraries in forestry.

Meanwhile the Society of American Foresters cannot admit to full professional membership, on their degree alone, the future graduates from schools of less than accepted standards, but must require of them further evidence of having attained the adequate basic theoretical training required by the Society as the equipment of a professional forester in the United States.

Idaho Forestry School Students from Many States

THE enrollment at the School of Forestry, University of Idaho, for the present school year totals 321; last year's total was 254. There are 2 graduates, 29 seniors, 51 juniors, 98 sophomores, and 141 freshmen. Of the total number 152, or nearly 50 per cent, come from states other than Idaho. This is most unusual in a school whose enrollment is practically all undergraduate.

The western states, as would be expected, have the larger out-of-state representation; California is first with 25, Washington a strong second with 22. The surprising thing is the comparatively large number of eastern students; Massachusetts with 10, Wisconsin 13, Pennsylvania 6, Illinois 10, New York 5; and even far away Florida is represented. In all, 30 states, Canada, and the Hawaiian Islands are represented.

From the standpoint of the profession and the school, this wide representation is a splendid thing. It would seem to indicate that the profession of forestry is no longer little known or less understood. We at Idaho feel we are particularly fortunate in having such an unusual student body to work with.

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THE ROLE OF MYCORRHIZAE IN AFFORESTATION[1]

By A. B. HATCH

This paper has large implications. It reports an experiment in which pine seedlings grown in prairie soil were found incapable of normal growth except when artificially provided with mycorrhizal fungi. It has been suspected for many years that mycorrhizal fungi are essential for the normal growth of forest trees. Unless mycorrhizal fungi are introduced in prairie soils through one means or another, the growth of trees planted in them may be unsatisfactory or completely lacking. The extensive program of afforestation in the prairie region as contemplated in connection with the shelterbelt project makes additional research on this problem imperative.

THE suitability of the American prairies for growing "adaptable" trees depends, according to current opinion, on three primary factors: the annual precipitation, the character of the soil, and the adequacy of the cultural and protective care given the plantations during early life.

But 16 nursery and plantation failures have occurred in widely separated regions of the world where these factors were carefully considered and eliminated as contributing agents (10, 1, 14). Moreover in these cases cultivation, fertilization, and watering of seedbeds were not effective in bringing about normal seedling growth. The cause of failure in all cases was eventually traced to the lack of a biological factor in the soils; a factor whose presence is essential to the normal growth of trees in nature.

Descriptions of Nursery Failures

The first failure occurred a decade ago in Western Australia (10). It very nearly caused the abandonment of one of the most extensive afforestation projects on record. At the outset 14 nurseries were started in widely separated areas. The seeds germinated and produced seedlings which were quite healthy during the first few months. Thereafter they became yellowish or purplish, their growth gradually diminished, and finally many died. I the same soils agricultural plants thrivec In a few spots pine seedlings also grev normally, and these were found to posses mycorrhizae, while all other pines lacke them. A few seedbeds were then inocu lated with soil containing mycorrhiza fungi. In these the plants soon recovere and showed no further difficulties. Even tually all seedbeds in the 14 nurserie were inoculated, and the project wa saved from abandonment. (Kessell, S. I The dependence of pine on a biologica soil factor. Empire For. Jour. 6: 70-74 1927.)

In the Rhodesian nursery failure (1 the pines grew to a size sufficient fo field planting, but they always remaine yellow and weak and they never exceede 4 inches in height. After fertilization an other treatments had failed to bring abou improvement, seedbed inoculations wei resorted to with spectacular results sim lar to those first reported from Australi Mycorrhizal pines from the treated seed beds were transplanted to the field sid by side with the non-mycorrhizal ones c two years earlier. In nine months the my corrhizal plants had grown to a heigh of 13 inches while their non-mycorrhiza 2½-year-old neighbors were still les than 4 inches in height. Small quan tities of soil containing mycorrhizal fung

[1]Contribution from the Arnold Arboretum Laboratory of Plant Pathology and the Harvar Forest, Harvard University. The author's address is now Department of Botany, Oregon Stat College, Corvallis, Oregon.

ere then worked into the seedbeds of ne which had been left over in the ırsery from the earlier planting: within month these seedlings turned a dark een and commenced vigorous growth.

In the Philippines the situation was still ore striking (14). Attempts were first ade in 1909 to extend the natural highnd range of *Pinus insularis*—the most ıluable softwood in the islands—to the wlands. Seeds of this tree planted in ırsery beds at Los Baños germinated ɔrmally, but the seedlings grew poorly espite cultural treatments. Eventually ey all died. Identical failures were freıently experienced in the following ears, and seeds of *Pinus insularis* which ere sent to South Africa and the Haaiian Islands were no more successful hen planted in the lowlands, although ey thrived at higher elevations. This idence appeared to indicate that *P. inılaris* was not adapted to the climate of e torrid lowlands. However, potted edlings from the nursery at Baguio, Mt. rovince, Philippine Islands, located ithin the natural highland range of this ɔecies, were planted at Los Baños (in e lowlands) in 1919, 1922, 1927 and gain in 1929. These trees thrived from e very beginning. They have averaged ver a meter a year in height growth ever nce, a growth-rate which is nearly twice at of the pine in its natural range. ubsequent use of soil collected from round the roots of these successful trees the nursery at Los Baños has wholly iminated the former difficulties.

Although it does not concern a nursery ilure, no account of these remarkable vidences of the dependence of trees on biological soil factor would be comlete without reference to the first case f such dependence ever recorded. In is classical example, Melin (12) demonrated that the growth of pine and ɔruce in newly drained peat bogs in ɔrthern Sweden was dependent upon the introduction into those bogs by the wind of the spores of mycorrhizal fungi. Growth of seedlings in the bogs was found to be directly proportional to the number and development of mycorrhizae. Lacking infection by mycorrhizal fungi, the seedlings invariably died. Thus the evidence pointed to these fungi as the specific biological factor which was necessary for the survival of trees in drained peat bogs.

Brief mention may also be made of several other reports of seedling difficulties in which the evidence points to a biological soil factor (probably mycorrhizae). In South Australia Samuels (17) attributed the failure or unsatisfactory results of the seed-spot method of reforestation to the absence or sporadic occurrence of mycorrhizal fungi in the seeded areas. In England, Stevens (18) reported that the broadcast seeding method is eminently successful if practiced shortly after logging; but if a period of years is allowed to pass before seeding, the method is unsuccessful. In this connection it is known that mycorrhizal fungi soon disappear from the soils of cleared woodlands (16). According to Laing (11), it is common knowledge among foresters that seedlings in newly established nurseries in England do poorly during their first year, when they lack mycorrhizae. As the mycorrhizal fungi become established (probably by wind-blown spores from surrounding woodlands), the seedlings first commence normal growth.

Significance of These Failures

The first four of these examples in particular afford striking support for the view that mycorrhizae are essential to the life of trees. Unfortunately the evidence is circumstantial only. Inoculation of seedbeds with *pure cultures* of mycorrhizal fungi would alone have supplied incontrovertible proof (such as was adduced long ago for the nodule-bacteria of

legumes) that mycorrhizal fungi rather than other soil organisms were responsible for these remarkable recoveries. Nevertheless, the failures point unquestionably to the need for recognizing the lack of appropriate soil organisms as a limiting factor to the growth of trees in prairie regions.

Experimental

An opportunity to obtain freshly collected soil from the American prairies prompted the writer to initiate a small and exploratory study of the mycorrhizal factor in afforestation. It was planned to learn: (1) whether ectotrophic[2] mycorrhizal fungi are lacking in the soils of that region, and (2) whether these fungi in reality are the specific soil organisms that are essential for tree growth in such soils.

The soil was collected by Dr. Paul A. Vestal and Mr. Richard H. Goodwin of Harvard University from a treeless tract 19 miles east of Cheyenne, Wyoming, and immediately shipped to the writer by express. It was evenly mixed with coarse silica sand (two-thirds sand) and potted in glazed bottomless one-gallon jugs. Twenty germinated seeds of *Pinus strobus* L. were planted in each of six containers in August, 1934. The containers were placed in a water bath and the whole protected from contamination by spores of mycorrhizal fungi by enclosing the water tank in glass and filtering through cotton the air forced into the chamber so formed. The plants were watered frequently with a slight excess of distilled water, and the excess allowed to drain free of the system. Daylight was supplemented by 4½ hours of radiation from three 200-watt tungsten filament lamps suspended 10 inches above the seedlings.

By early November the seedlings in all six containers were small, yellow, and unthrifty in appearance. They had already set bud and gone into winter dormancy, a process which occurs much earlier in pine seedlings grown under conditions of low nutrient availabilities than in those with larger supplies of nutrients. Examination revealed that mycorrhizae were wholly absent.

The seedlings in three of the containers were then inoculated with pure cultures of the following mycorrhizal fungi: *Boletus luteus, Boletinus pictus, Lactarius deliciosus* L., *L. indigo* (cultured by Dr. K. D. Doak), and *Mycelium radicis nigrostrigosum* (6, 7). The plants were kept at low temperatures during the winter (fluctuating with the temperatures in the unheated greenhouse, the water being removed from the water-bath). In March the containers were removed from the glass enclosure and placed in the open air of a heated greenhouse.

Between the first of April and the last of May differences in the appearance and size of the seedlings became apparent. The new needles on the inoculated seedlings in pot 2 were the first to become dark green and to elongate rapidly. These changes appeared later in the inoculated seedlings in pot 3, and finally in pot 4. The new needles on the seedlings in the uninoculated pots, except in pot 5, remained yellow and short throughout the experiment. Early in May the yellow color reappeared in the leaves of seedlings in pot 2 as well as in those in pot 5.

[2]*Ectotrophic* mycorrhizae (5) are "absorbing" organs in which the fungus forms a parenchyma-like mantle over the exterior of the root, effectively separating it from the soil. The fungus likewise normally penetrates between and separates from one another the cells of the primary cortex. In the other type of fungus roots, known as *endotrophic* mycorrhizae, the fungus does not form an exterior mantle but grows chiefly within rather than between certain of the cells of the primary root cortex.

The plants were harvested between May 7 and June 5, at which time the root ystems were examined for mycorrhizae nd silhouette photographs (Figs. 1-3) ere taken. In pot 2 the short roots, any of which had been mycorrhizal, ere all dead. In pot 3 approximately 0 per cent of all short roots were myorrhizal. They were produced by *Boetus luteus* except for a few dozen which ere formed by *Lactarius deliciosus* at he point at which the inoculum was inroduced into the soil. In pot 4, in hich *Boletinus pictus* had been introuced, the mycelium spread only slowly rom the point of introduction. Thirteen f the twenty seedlings in the pot had pwards to 90 per cent of their short root converted to mycorrhizae (Fig. 2).

The plants were dried at 65 degrees C. and the individual weights of the roots and tops of each plant determined. From each pot four seedlings whose weights were close to the mean weight of all seedlings in each pot were analyzed (tops and roots separately) for nitrogen, phosphorus, and potassium. The methods of analysis used were developed for resinous materials by Professor P. R. Gast (3) at the Harvard Forest. For nitrogen a modified form of the micro-Kjeldahl method of Pregl (13) was used. After perchloric acid digestion, phosphorus and potassium were determined colorimetrically (2,9). The results are presented in Table 1.

TABLE 1

RY WEIGHTS, ROOT-SHOOT RATIOS, AND NITROGEN, PHOSPHORUS, AND POTASSIUM CONTENTS OF YCORRHIZAL AND NON-MYCORRHIZAL WHITE PINE SEEDLINGS RAISED IN PRAIRIE SOIL, INCLUDING COMARISONS WITH LOWEST PERCENTAGES OF N, P, AND K HITHERTO RECORDED FOR THIS PINE IN SOILS AND IN NUTRIENT SAND-CULTURES

		Root-	Nitrogen		Phosphorus		Potassium	
ot No.	Av. dry weights of seedl. in mg.	shoot ratio	mg per seedl.	% of dry wt.	mg per seedl.	% of dry wt.	mg per seedl.	% of dry wt.
1	360.7 ± 8.7[1]	1.024	2.51	.695	.268	.0742	1.94	.539
2[2] (inoc.)	428.5 ± 19.2	.9176	3.01	.703	.566	.1320	1.93	.450
3 (inoc.)	448.4 ± 9.9	.672	5.39	1.202	.849	.1893	3.47	.775
4 (inoc.)	360.9 ± 4.8	.892	4.62	1.280	.729	.2021	2.57	.713
5	300.0 ± 7.0	1.365	3.16	1.056	.229	.0762	1.04	.347
6	301.4 ± 4.8	1.024	2.40	.795	.211	.0700	1.17	.390
verages mycorrhizal seedl., pots 3, 4....	**404.6**	**.782**	**5.00**	**1.241**	**.789**	**.1957**	**3.02**	**.744**
verages non-mycorrhizal seedl., pots 1, 5, 6	**320.7**	**1.138**	**2.69**	**.849**	**.236**	**.0735**	**1.38**	**.425**
owest values hitherto recorded for 3-months white pine seedlings grown in any soil.[3]				1.081		.0825		.335
er cent of N and P in 3-months white pine seedlings grown in nutrient sand-cultures in which these elements were individually omitted; all other elements being optimal.[4]				.720		.1040		None available

[1] Standard error of mean.

[2] In pot 2 mycorrhizae were produced early in the season but at the time of pulling all were ead as evidenced by complete suberization of cortex. The values for seedlings in this pot re intermediate and they are excluded from the averages.

[3] N and P values from seedlings grown in Ridge soil, Black Rock Forest, Mitchell (13, able 7; P values not reported); K values from seedlings grown in very infertile soil (Mitchell, npublished).

[4] Described (Mitchell, 13, Tables 3, 4 and 14) but, except for N values, unpublished results of litchell.

The facts that are of outstanding interest in this table are: (1) the marked increase in the absorption of nitrogen, potassium, and especially phosphorus by mycorrhizal plants (86 per cent more N, 75 per cent more K, and 234 per cent more P than in non-mycorrhizal plants), and (2) the obvious starvation of non-mycorrhizal plants as revealed by comparison with the lowest known percentage contents of these elements in white pine seedlings grown (a) in other infertile soils, and (b) in nutrient sand-cultures in which nitrogen or phosphorus was completely omitted.

It is believed that this evidence is conclusive in showing that the white pine seedlings grown in this prairie soil did not obtain sufficient nutrients to suppo normal growth when mycorrhizal fun were absent.

Significance and Application in Afforestation

These results, although few and ex ploratory in scope, when viewed in th light of the nursery failures describe above, would seem to establish (1) tha mycorrhizal fungi are lacking in the soi of the American prairies (see Harvey, 4 in common with those of other unforeste regions (except where trees have been in troduced as transplants), (2) that in th absence of mycorrhizal fungi the absorp tion of nutrient elements by trees is ap

Fig. 1.—Non-mycorrhizal seedlings of *Pinus strobus* L. grown in prairie soil (pot 1).

› be inadequate to support normal rowth, and (3) that mycorrhizal fungi onstitute the specific biological factor hich is necessary for the survival of ees in prairie regions.[3]

This knowledge may be put to immeiate practical use in afforestation prace in prairie regions. When trees are ansplanted from one region to another, estructive pathogens as well as mycorhizal fungi are also transplanted to the ew region. Both types of organisms are also transported to new regions when soil is used as the medium for introducing mycorrhizal fungi into new nurseries (see descriptions of Australian, Rhodesian, and Philippine nursery failures). To exclude the pathogens new nurseries and afforestation projects should be started using seeds only (already recommended for American projects). But if the trees in these nurseries are to survive, mycorrhizal fungi must be introduced artificially. Pure cultures of these fungi[4] or,

ig. 2.—Four mycorrhizal and one (right) slightly mycorrhizal seedlings of *Pinus strobus* L. grown in inoculated prairie soil (pot 4).

[3]These results, in common with others (8), modify fundamentally the theory of mycotrophy in trees as it is now generally accepted. They will be discussed in this connection in a subsequent publication.

[4]The identities of the fungi producing endotrophic mycorrhizae are unknown, and with one exception among trees, they have not been obtained in culture.

if techniques can be developed, their spores of fructification, can alone be used for this purpose.

The application of these principles to nursery practice in afforestation projects will make possible (1) the exclusion of pathogens, (2) the survival of trees planted in areas where soil and moisture conditions are suitable, (3) the accumulation of exact data on the relative growths of trees inoculated with different species of mycorrhizal fungi and planted in different habitats.

Since it is known that different species of mycorrhizal fungi vary in their abilit (1) to produce mycorrhizae with differer trees, (2) to survive in different habitat and (3) to stimulate tree growth, th early accumulation of field data on thes variables is of vital importance to th success of afforestation projects.

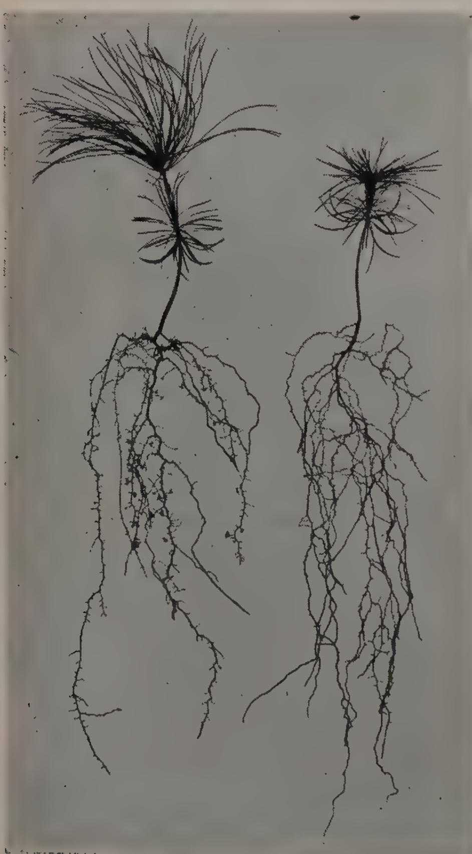

Fig. 3.—Mycorrhizal (left; pot 3) and non-mycorrhizal (right; pot 6) seedlings of *Pinus strobus* L. grown respectively in inoculated and uninoculated prairie soil.

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THE MONT ALTO STATE FOREST

By HENRY E. CLEPPER[1]

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Pennsylvania has frequently been called the cradle of American forestry. As might be expected, considerable time is required for even a keen and practiced observer to inspect all the state's various woods operations. But it is not necessary to travel the length and breadth of the commonwealth in order to study Pennsylvania forestry at first hand; the same end may be reached by a visit to the well known Mont Alto State Forest. Although only a single, comparatively small administrative unit of the state Forest Service, this area affords a clear cross section of the history, the physical background, the present character, and the trend of forestry in Penn's woods.

IN 1902 the late Dr. Joseph T. Rothrock, now known as the father of forestry in Pennsylvania, was Commissioner of Forestry. During that year, on his advice. the commonwealth purchased a tract of some 23,000 acres in Franklin and Adams Counties from the Mont Alto Iron Company, at a cost of $80,000, to be developed as a State Forest.

This area, though largely clear cut to furnish wood for the charcoal used in the local iron smelting furnaces, and considerably devastated by fire, was not only one of the earliest acquired by the commonwealth, but was destined to become one of its best known State Forests. George H. Wirt, a graduate of the Biltmore Forest School and the first technically trained forester employed by the commonwealth, was placed in charge.

That same year were started two important activities, which, as time showed, were to have a profound influence upon the course that forestry was to take in the state. Development of the Mont Alto nursery, now the oldest State Forest nursery in Pennsylvania, was begun, and the groundwork for the establishment of the State Forest Academy, the first professional forest school in Pennsylvania, was laid. The following year the legislature officially established the school, which was immediately able to function because the curriculum had previously been worked up.

It was in 1903 also that the well known Mont Alto arboretum was started, for, almost simultaneously with the establishment of the forest school, trees, both native and foreign to the Cumberland Valley and South Mountains, were planted on the grounds of the academy and nursery. Practically every species of tree and shrub native to Pennsylvania and adjoining states is now growing in the Mont Alto State Forest. In addition one may find here many species and varieties foreign to the state but representing types common to the world's North Temperate climate. Concerning the value of this arboretum to forest practice in the state, more later.

The somewhat unique position attained by the Mont Alto State Forest, during the past thirty years and more, as the demonstration forest of Pennsylvania forestry, was neither brought about suddenly nor by deliberate intent. As a matter of fact, it was the presence here of certain fortuitous and favorable circumstances that combined to make this area an ideal proving-ground for forest practices. For in addition to the school, the nursery, and the arboretum, almost from the beginning

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ere had been a forest sawmill in opera-n. Moreover, interesting reforestation oblems presented themselves, and the rticular region of which the forest is a rt had long been noted for the variety d abundance of its natural flora.

It should be explained that the Cum-rland Valley and South Mountains lie both Pennsylvania and Maryland. The ont Alto State Forest, which extends om the valley foothills up and over the ountains, is situated only a few miles rth of the famous Mason and Dixon's ie. Accordingly, the forest happens to the meeting place where the northern-ost fringe of southern species mingles th the southernmost outpost of northern ees.

By way of illustration, southern yellow ne, whose commercial range penetrates r only a limited distance into Pennsyl-nia, grows within the same State Forest ere may be found what is believed to the southern limit of gray birch, ich, as is well known, is a species culiar to the northern hardwood for-ts. Likewise, the laurel magnolia, a e southern species, reaches the cold nit of its range at the same latitude as e trembling aspen's warm limit. Other mparisons, or rather instances of dis-rity, may be cited to indicate how fer-e is the ground that the Mont Alto ate Forest provides for the study of vics alone; for example, papaw, holly, inquapin, persimmon, and laurel oak, sentially southern species all, grow in e same general locality with yellow ch, wild black cherry, and sugar maple.

The Arboretum

The Mont Alto arboretum was an out-owth of two necessities. With the unding of the Pennsylvania State For-t Academy in 1903 it became apparent at, for the study of dendrological and vical characteristics of trees by student foresters, a wider range of living speci-mens of woody flora than occurs naturally in the South Mountains was needed. Furthermore, it was soon found neces-sary to obtain information to guide the selection of exotic forest trees for refor-estation in Pennsylvania.

It should be explained that this arbore-tum was established and developed, not as a show place, but rather as a field laboratory where tests and observations could be made of the silvical characteris-tics of native and foreign trees under Pennsylvania climatic and soil conditions. During the past 30 years the inventory of the regional flora has been increased by introduction and exploration to nearly 500 species, classified in 48 families and 110 genera. A key sketch of the arbore-tum area shows the location of the mate-rial on display. There are now about 1,500 stations designated.

A world-wide seed exchange has been established with experiment stations, for-est schools, botanical gardens, and state and federal forest services all over the North Temperate Zone. Cooperation has been maintained with the Foreign Plant Introduction Service, and cooperative ex-periments have been carried on with the Eddy Tree Breeding Institute. Specimens for herbariums and seed collections are furnished by the arboretum, as well as seed and planting stock for exchange with other agencies. One of its most valuable services has been the production of planting stock for testing in experi-mental plantations in the State Forests.

In short, it will be seen that by its use as a field laboratory for cooperative ex-periments the Mont Alto arboretum aids foresters in the search for knowledge about trees. Moreover, in the attainment of its objectives it helps to promote and lends balance to the forestry program of Pennsylvania.

The Nursery

The first seed planted in beds for raising trees for the Pennsylvania State Forests was six pounds of white pine seed sown in April, 1902, at Mont Alto. From that humble beginning the Mont Alto State Forest nursery has grown to an area 16 acres in size with a current inventory of eight millions of seedlings and transplants, and an annual production of from three to four millions. From 1903, when the first seedlings were lifted, until the close of operations in the fall of 1935, more than 50 millions of trees were shipped from this nursery.

Soil, climate, and growing seasons combine to make Mont Alto a favorable location for a nursery site. With an evenly distributed average annual rainfall of about 40 inches and a mean temperature of 52 degrees, it is possible to raise the kind of vigorous, stocky seedlings which are especially suited for reforestation in southern and central Pennsylvania. Because of favorable weather conditions it is usually possible to start lifting and shipping seedlings as early as March. Killing frosts seldom occur after May first, and not usually before early October. Consequently the nurseryman is assured of at least five and one-half months without frost.

The principal species raised in the nursery in the order of their relative numerical importance are white pine, red pine, pitch pine, Scotch pine, Banks pine, the larches, Norway spruce, white ash, black locust, red oak, black walnut, and yellow poplar. Other species, both coniferous and deciduous, have been produced, but in limited quantities only.

Although the primary function of the nursery is to produce trees for reforestation in Pennsylvania, it serves an important though secondary purpose, that of a field laboratory for research studies. Among the special investigations being carried on currently, a most interestin one is a study of the ubiquitous damping off diseases, a cooperative enterprise be tween the Pennsylvania Department o Forests and Waters and the U. S. Depart ment of Agriculture. Furthermore, th nursery serves as an outdoor laborator where students attending the Pennsyl vania State Forest School obtain instruc tion and training in nursery methods.

Because of increased demands for seed lings, particularly by Emergency Con servation Work and Soil Conservatio Service projects, the output of the Mon Alto nursery is now being increased b at least one million trees yearly.

Forest Research

Although silvical studies and fores experiments of various kinds had bee carried on in Pennsylvania ever sinc the inception of the State Forest progran it was not until 1920, when an Office o Research was created in the then Depar ment of Forestry, that any organized a tempt was made to give the research pro gram continuity and permanency. Prio to that time, studies were carried on prin cipally at Mont Alto in connection wit the operation of the forest school. Henc the research effort was mainly the inte est of faculty members and only inc dental to their teaching activities.

During the decade following 192 from two to six foresters carried o intermittent studies, working out of th Harrisburg office. In 1930 a separa institution, devoted exclusively to fore research, was officially opened at Mon Alto. It was staffed with a directo four research foresters, and an entomo ogist. Since that time, largely as a r sult of economic conditions in the sta with their consequent effect on gover mental activities, the staff has been c down to three state-employed foreste However, working in this Mont Alto offi of the Division of Research are two fe

rally employed men, one a pathologist, esides other temporary and non-technical assistants.

Among the important problems being ivestigated by this research staff are:

1. The replacement of chestnut in ennsylvania.

2. Growth and yield of important timer species and several forest types.

3. Damping-off in nursery beds.

4. The use of chemicals in forest fire xtinction.

5. A correlation of game and forest ıanagement by cuttings designed to inease the production of game food and ver as well as of timber.

6. Seed testing and classification.

7. A correlation of weather records ith tree growth.

8. Computation and analysis of the ock survey now being undertaken on oout one and one-half million acres of ennsylvania State Forests by ECW laɪr.

The forest research program at Mont lto has suffered restrictions because of nited personnel which has resulted from ck of funds. One of the principal projts was a study of important forest tomological problems; this program s been inactive for two years. Hower, perhaps enough has been written to licate that a balanced research program under way. Furthermore, it should be plained that additional research projs, including a state-wide wood utilizan study, are being carried on from Harrisburg office.

Some conception of the scope of the rk in progress at Mont Alto may be tained when it is explained that active ords are on file there, and periodic asurements are made, of more than) permanent study plots, distributed oughout the state in every forest type l in all ages and conditions of stands, h natural and artificial.

The Forest School

As we have seen, the Pennsylvania State Forest Academy came into existence as the result of an act of legislature passed in 1903 which provided for a forestry school at Mont Alto. This school was the first in the state to furnish instruction in forestry. The course was three years in duration with 33 months of actual work. Four years later a second forest school began operations, when the first registrations in the newly organized Department of Forestry at The Pennsylvania State College were made for the spring of 1907.

Both schools continued to function until 1929 when, because of "conditions in the Department of Forests and Waters, financial and otherwise," the two schools were joined, and forestry instruction in Pennsylvania was confined to State College. The plant and other facilities at Mont Alto are still used, however. Under the present arrangement freshmen students taking the four-year course go to Mont Alto, where, in addition, a summer school is held for sophomore students. The present resident faculty numbers 10 men and the student body, 150.

The Forest

The Mont Alto State Forest contains 23,537 acres, divided into 33 compartments. It consists mainly of third-growth, even-aged hardwoods. Information collected by a stock survey, made during 1934 by enrollees in ECW Camp S-70 under the supervision of Research Forester Geo. S. Perry, indicate that there are close to five million trees with a diameter of three and one-half inches and over in the forest. The total volume is 71,692,000 board feet (or 31,801,000 cubic feet).

On the basis of individual tree count, rock oak makes up 44 per cent of the total stand, with about two million trees.

Numerically, scarlet oak is second with 18 per cent; followed by red oak and pitch pine, with 6 per cent each. Red maple, black oak, and white oak each comprise 5 per cent of the stand; white pine and black birch each 2 per cent; and tulip, black locust, black gum, and pin oak each 1 per cent. The remaining 3 per cent is made up of 36 other species, including hickory, white ash, hemlock, and aspen.

As might be expected, on the basis of merchantable volume rock oak leads, with 18,000,000 board feet; scarlet oak is second, with 13,000,000 board feet; followed by pitch pine, 8,500,000 board feet; red oak, 8,400,000 board feet; black oak, 4,275,000 board feet; and white oak, 2,000,000 board feet. White pine, which comprises a scant 2 per cent of the number of trees in the forest, and red maple, which comprises 5 per cent of the total number, each has a volume of approximately 2,000,000 board feet. Similarly, tulip, which comprises a shade less than 1 per cent in numbers, has a volume of nearly 2,000,000 board feet.

Curiously enough, the species in the forest having the highest percentage (87 per cent) of merchantable trees is shortleaf pine, but there are only 310,000 board feet of this desirable kind. However, as a compensation, 40 per cent of the pitch pine is merchantable, as is 67 per cent of the hemlock, 52 per cent of the tulip, and 50 per cent of the hickory. Of our most numerous species, rock oak, less than 14 per cent is merchantable.

When taking this much needed inventory of the growing stock in the Mont Alto State Forest the crews measured mean sample trees. It is interesting to note that the mean sample tree of rock oak, the most numerous species as well as the one with the highest volume, has the following dimensions: d.b.h., 7.9 inches; height, 46.4 feet. On the basis of crown classification, 6 per cent of the rock oak trees are dominant, with an ag of 61 years; 42 per cent are codominant with an age of 47 years; 38 per cent ar intermediate, with an age of 38 years and 14 per cent are suppressed, with a age of 40 years.

Of the forest types represented th most extensive is the "mixed oaks-pitc pine type" which comprises 87 per cen of the total area. The so-called cove typ is second in importance, comprising per cent of the area. Scrub oak is third comprising 3 per cent.

On the basis of density for the entir forest, 68 per cent of the stand is normal 21 per cent is thin, 8 per cent is close and 3 per cent is open. Only an infini tesimal acreage, and that in plantations may be said to be overstocked.

Generally, the Mont Alto State Fores is well stocked with slow growing hard woods, principally oaks. The stands ar normally dense and will profit from im provement thinnings. Better increment i almost certain to result from thinning if rock oak is discriminated against i favor of species with faster growth rate and merchantable possibilities.

The annual growth for the entire fore has been calculated at 12,500 cords. I has been estimated that the equivalent o 10,500 cords may safely be cut each yea Because of limited markets for sma dimension hardwoods, only about 25 p cent of the permissible cut has been r moved annually. The principal oper tion at present active is a contract f 1,500 cords of pulp wood to be deliver by August 1, 1935.

The forest has two extensive recre tional areas—the Mont Alto State Fore Park, a 500-acre tract in operation as park since Civil War days, and the O Forge public camp, a 200-acre picnic a camping ground with numerous faciliti for public comfort.

Two modern steel observation tow

verlook its wooded acres. There are bout 60 miles of primary and secondary orest roads or truck trails. Five small ate game refuges, totalling about 2,000 cres, have been established. It is one f the best stocked game regions in a ate nationally known for the abundance f its wildlife.

To summarize, few American forest reas have been managed on a sustained ield basis for as long as the Mont Alto tate Forest—30 years. But it has been s a woodland laboratory rather than as n administrative unit that the forest has tained its nation-wide reputation as an bject lesson in forestry practice.

In short, without exaggeration it may e said that within the Mont Alto State orest are to be found examples of praccally every forestry activity carried on the 1,648,000 acres of the Pennsylvania tate Forests. Perhaps, however, that condition is to be expected in view of the influences brought to bear upon the forest by those who at various times have been in actual charge of it or who have at least controlled its administrative destiny. In addition to the gentlemen previously mentioned in this article, among those who have left the imprint of their personalities upon the Mont Alto woods have been Robert S. Conklin, Gifford Pinchot, Major R. Y. Stuart, Lewis E. Staley, Dr. E. A. Ziegler, Dr. Joseph S. Illick, and numerous others. It is believed by many foresters that the best interests of the Department of Forests and Waters, and inferentially of the citizens of Pennsylvania, will be served by building a statewide system of forest practice on the foundation so firmly established by these men. Consequently, the personnel in charge of the Mont Alto State Forest is sticking to that job.

A NEW METHOD OF MEASURING TRANSPIRATION

By LEON S. MINCKLER
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THE profession of forestry is beginning to feel the need of definite knowledge concerning the water relations of trees, especially transpiration. This was brought out clearly in discussions of the proposed shelter-belt. One of the newer texts on silviculture emphasizes that silvics is based on physiology and ecology and points out the need of more exact quantitative measurements. To date there has been no satisfactory quantitative method of measuring the transpiration of full grown trees in their native habitat. While data on transpiration of agricultural plants are abundant, data for forest trees are practically nil. As an example of the data available, the work of Höhnel (taken from Horton) (2) can be cited. In 1879-81 he determined the transpiration of a large number of trees of several different species. He used amply watered, four- to five-year-old potted seedlings. The water transpired by an individual tree was determined by weighing the entire plant at definite time intervals. Since then Höhnel's data have been used almost exclusively as a basis for quantitative estimates of tree transpiration. This is unfortunate because data collected from potted tree seedlings give erroneous results when applied to large trees growing in the forest.

A method has been devised by the writer which makes it both possible and practical to calculate the transpiration of full-sized trees growing in the forest. The measurements are quantitative (not relative, as in the cobalt chloride method) and reasonably accurate. The principle employed is essentially that used by Freeman (1), that is, the water transpired during a definite time by a group of leaves *in situ* is absorbed by a hygroscopic substance and calculated.

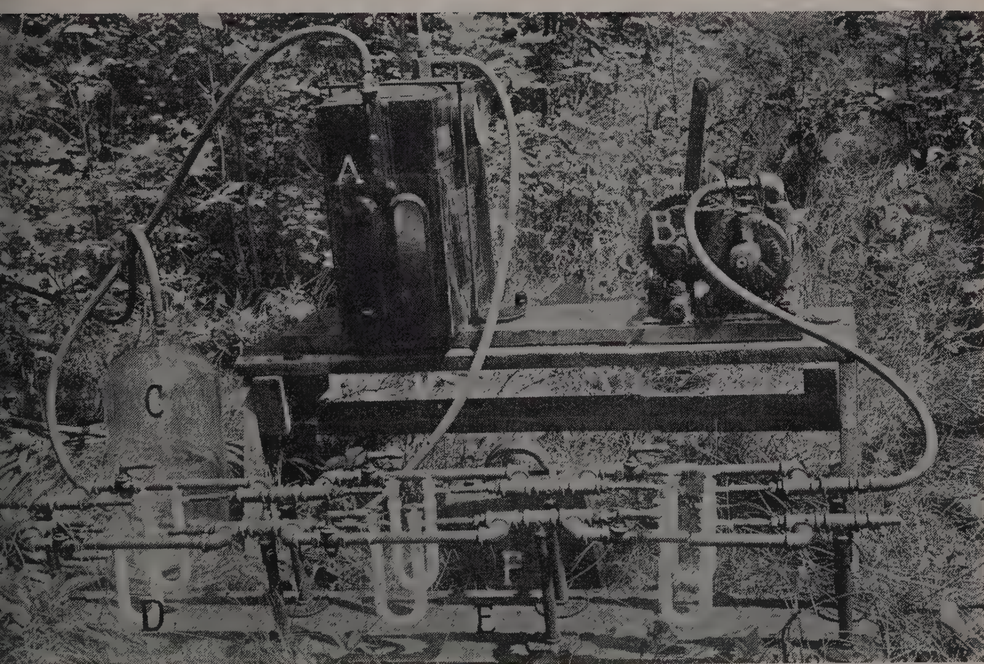
An illustrated description of Freeman's method will be found in Miller (4) and Maximov (3). Only a brief summary of the method will be given here. A siphon or aspirator serves to draw air over the transpiring leaves, enclosed within a small glass chamber, and through U-tubes containing phosphorus pentoxide, which absorbs the water vapor from the air. A control is run at the same time to determine the amount of water in normal air; that is, air with no moisture added by the leaves. The volume of air passed through is equal to the volume of water drawn from the siphon. Freeman checked this method against potometers and found substantial agreement. Theoretically the method is good, but its application is far from perfect, and various workers (3, 4) have pointed out several rather serious defects.

Due to inconvenience in operation Freeman's apparatus is wholly unsuited to extensive field work. Moreover, the flow of air induced by a siphon is too slow and its force is too small to satisfactorily cope with ordinary conditions. In the experiments conducted by Freeman the air flow totaled 19.5 liters per hour. This rate is not sufficient to prevent condensation of water vapor on the inner walls of the chamber when it lies in direct sunlight. This slow flow of air also makes it necessary to use a very small chamber, which in turn excludes the possibility of working with large leaves. As mentioned the force of a siphon is weak, and unless the resistance in the line is kept sufficiently low, the flow of air is retarded even more or ceases altogether. Any hygroscopic substance has considerable resistance to air

ow and this is especially true of phos-horus pentoxide, which has a tendency o liquify and harden. Moreover, in the etermination of transpiration in the top f a tall tree the resistance would be ncreased even more, due to the length f line connecting the chamber to the J-tubes.

The method can also be severely criti-ized because it encloses the transpiring eaves in a glass container over a long eriod of time. In Freeman's experi-nents, the alfalfa sprig was left in the hamber for an hour, and, although the ir was continually renewed, both the emperature and the humidity were con-iderably higher on the inside than on he outside. These abnormal conditions, cting on the leaves for a relatively long eriod, affect the transpiration. Finally, n this method, no provision is made to void error due to starting and stopping he experiment.

In the present method the mechanical application of the principle advanced by Freeman has been modified so as to correct the defects mentioned above. The essential procedure is the same, that is, air is drawn over leaves enclosed in a glass chamber, and through U-tubes where the water vapor is absorbed. Figure 1 shows the apparatus as set up and used in the field. A hand operated, positive pressure Crowell air pump serves to draw air through the system. A gas meter, reading to one-hundredth of a liter, measures the volume of air. These two instruments are assembled in a unit by being mounted on a wooden base. The drying agent is contained in Schwartz U-tubes fitted with ground glass stop cocks. The U-tubes are held by a specially constructed holder made from three-eighths inch brass pipe, and, as Figure 1 shows, its capacity is six U-tubes in two series of three. In order to avoid errors due



ig. 1.—Apparatus used in measuring transpiration. A—Gas meter; B—Air pump; C—Transpiration chamber; D—U-tube; E—Base of U-tube holder; F—Weston photometer.

to starting and stopping the experiment, a by-pass with a valve is provided for each U-tube. Their mode of operation will be explained later. The transpiration chamber which encloses the leaves is a bell jar with a tubulated top. It is 18 inches high and 8 inches in diameter. About 90 feet of three-eighths inch (inside diameter) rubber hose connects the chamber to the pump-meter ensemble and the U-tubes.

Inasmuch as the drying agents employed constitute one of the important features of this method, a word should be said regarding them. Freeman and most other workers have used phosphorus pentoxide. This chemical is difficult to handle; moreover, due to its property of liquifying and hardening, it is not suitable when the flow of air is relatively rapid. Two new drying agents[1] "anhydrone" (anhydrous magnesium perchlorate) and "desicchlora" (anhydrous barium perchlorate) proved to be excellent. Both have extremely high absorbing powers and a high porosity which is retained until the chemical is practically saturated with water. Glass wool is required only at the outlet of each U-tube, and a given tube can be used repeatedly without refilling. Anhydrone is the more powerful drying agent (but expensive), consequently the best practice is to use desicchlora in the first tube and anhydrone in the second and third. The use of three U-tubes filled with these chemicals, the employment of a powerful air pump, and the use of a large transpiration chamber make it possible to prevent condensation, if too much foliage is not used, even in direct sunlight. This has been shown by extensive use in the field.

As mentioned previously, the maximum air flow in Freeman's experiments was at the rate of 19.5 liters per hour. In the present method the air flow is about 5 to 10 liters per minute, with an average of about 8. This is approximately 25 times faster and permits the use of a transpiration chamber of sufficient size to accommodate 20 to 30 or more relatively large tree leaves. Moreover, the duration of the experiment is but 6 minutes instead of an hour. It is believed that, under the conditions of the experiment, 6 minutes is far too short a time for any effect due to enclosure of the leaves to become operative.

The procedure in conducting the experiment is as follows: The apparatus is se up on the ground as shown in Figure 1. A helper carries the transpiration chamber into the crown of the tree and the desired leaves are placed inside. The pump is started and the air is allowed t flow through the by-passes until the whol system is filled with air that has passe over the leaves. The flow of air is the shifted into the U-tubes and the experi ment run for exactly 6 minutes. Imme diately afterwards a control experiment i run in the same manner except that th leaves are removed from the chamber The same quantity of air is passed throug this second set of U-tubes. Correctio for volume expansion of the air is mad if the air temperature in the meter an the outside air temperature differ. Th difference in gain of weight (nearest mil ligram) between the two sets of U-tube is the amount of transpiration of th leaves. The gain in weight of the U tubes used in the control experimen divided by the number of liters of ai passed through, gives the amount of wa ter per unit volume of normal air. Th quantity of transpiration is expressed i grams of water given off by 1 squa meter of stomatal-bearing leaf surface p hour. The area of the leaves is dete mined by tracing them out on good qua ity paper the weight of which per un

[1]Suggested by Prof. C. R. McCrosky, of the Chemistry Department, Syracuse University.

rea is known. The tracings are cut out nd weighed. This weight divided by he weight of a unit area (square meter) f the paper gives the area of the leaves. Relative humidity and saturation deficit f the air can be calculated from the conrol data and a knowledge of the temperaure. Light intensity on the group of eaves is measured by a Weston photoneter, and soil moisture determinations re taken each day.

Considerable data are at hand in regard to the accuracy of this method. t is sufficient to say that the vapor ressure of water over anhydrone is pracically nil, which means that it is an xceedingly powerful absorber of water. On the average the third U-tube gains nly 6 per cent of the total water aborbed during an experiment. Consistent esults are obtained, and checks against sling psychrometer show, on the whole, lightly higher relative humidities for the hemical method. Lower results would e expected if the chemical did not absorb ll the water vapor.

A small sample of the data obtained y this method shows that, for the season f 1933, the average daily transpiration f an American elm, with a d.b.h. of thirteen inches, was 8.7 liters of water. For the growing season of 150 days this would amount to 1,360 liters. Assuming 375 trees per acre (approximately fully stocked stand), this is equivalent to 4.8 inches of rainfall. A red maple, growing in a very moist habitat and having considerably more foliage than the elm, had a daily average of 51.7 liters. This is 7,770 liters for the growing season, and again assuming 375 trees per acre it equals 28.3 inches of rainfall. It is planned to publish the data in full at an early date.

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WILDLIFE: AN IMPORTANT FOREST PRODUCT

By JAMES N. MORTON[1]

Wild life and recreation considerations are becoming increasingly prominent in the thought of foresters regarding forest management objectives and plans. Pennsylvania, through the constructive work of a forward-looking game commission, occupies an outstanding place in state accomplishments. Mr. Morton in this article has presented an excellent outline of that accomplishment, with facts and suggestions that might well be studied and emulated by other commonwealths.

THE most essential contribution of the Commonwealth of Pennsylvania to the recreational needs of its citizens has been its comprehensive and most successful program of wildlife conservation. Pennsylvania is famous today for her wildlife. During the 39 years of its existence the Pennsylvania Game Commission, through the gradual development and improvement of its game code, has turned the eyes of the Nation's sportsmen in its direction. The state's program of wildlife protection, acquisition of public lands, establishment of game refuges, propagation and distribution of game birds and animals, and the control of predators has resulted in establishing our wildlife as one of the biggest assets of the state. This has been a gigantic task when it is considered that the state was virtually destitute of game forty years ago, a task which could have been accomplished only with enthusiasm born of the highest sort of altruism and the most intense devotion to a cause.

One of the principal reasons for the success attained is our system of game refuges and public hunting grounds, which is considered among the best in the world. It is worthy of note that the ideas upon which the system is based originated in Pennsylvania and that its development was started almost thirty years ago. The first refuge established in Pennsylvania was in 1905, on State Forest land. The idea at once proved popular and successful. More were immediately set aside. A game refuge, as constituted in Pennsylvania, is nothing more than an area of good game breeding territory upon which no hunting whatever is permitted, and where game unmolested may live and multiply under natural conditions. All refuges are surrounded by a single strand of Number 9 galvanized wire and a brushed line 6 to 10 feet wide, and are conspicuously posted. To be useful to the hunter they must be placed in an area where surrounding public hunting grounds will be assured, in order that the game which radiates out from the refuge to the surrounding territory can be legally killed.

The first refuges established in Pennsylvania were intended primarily to protect deer, since that species of game had become practically extinct. The number of refuges was increased as the need arose and as areas became available. The intensive development by reason of Civilian Conservation Corps work on the state's forests during the past few months has made necessary the establishment of a number of additional refuges, particularly for the protection of small game. More than fifty were established during the summer of 1934, principally for the protection of wild turkeys. Thousands of acres of forest which for years were natural game refuges, due to their comparative inaccessibility, are now easy to reach. It is to protect game in som

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f these areas that the new refuges were stablished.

The initial purpose of creating a game efuge is to preserve the native seed tock existing within a certain area and o permit it to increase within its natural abitat unmolested. The major purpose f continuing the refuge is to prevent any ossibility of the territory becoming shot ut, even though overshooting occurs in he surrounding territory. As time passes he protected areas become of more imortance because of the ever increasing umber of hunters and the disadvantage nder which game must survive. The efuge supersedes restoration areas forerly inaccessible to hunters.

There is now maintained a total of 184 ame refuges in Pennsylvania, having a otal area of 127,587 acres; 75 are loated on State Game Lands, 64 on State orest land, 1 on National Forest land, nd 44 on privately owned land.

In conjunction with the establishment nd maintenance of refuges, the Game ommission has conducted, since 1920, a rogram of land acquisition. The total rea acquired to date is 458,228 acres, he largest proportion of which is forest and, with perhaps 5 per cent abandoned arms. Since 1927, seventy-five cents of he $2 from each resident license is, y law, set aside in a special fund for he purchase of lands and the creation of ame refuges, and the maintenance of he game refuges and lands.

It is becoming increasingly difficult to aintain a sufficient game crop for the reat army of outdoor enthusiasts. Ways nd means of accomplishing this have een developing in Pennsylvania over a eriod of many years. At first there ere simple regulations concerning Sunay hunting, and bounties on predatory nimals and birds. From there we have een a great many important enactments, mong which are the following: The creation of a Game Commission; the provision for seasons and bag limits for all game; the passing of laws prohibiting the use of dogs in hunting deer and prohibiting market hunting; the passing of a game refuge law; the passing of laws protecting black bear and protecting doe deer by permitting only bucks with antlers to be shot; the passing of a bounty law and the hunters' license law; and the passing of acts granting wide discretionary powers to the Board of Game Commissioners. It would be possible to go on and enumerate many more major steps taken for the purpose of safeguarding this ancient sport, and the end is not yet in sight.

It seems to me that we are approaching the time when another major step will have to be taken. This one has to do with the management of the environment for game in order to provide better conditions as to food and cover. This will of necessity be carried out over all possible forest territory, and for that reason foresters will need to give their wholehearted support. Unquestionably many will not agree that game is of sufficient importance to give it much consideration. I believe, however, that the time is past when foresters can simply ignore game or assume a hostile attitude. They are failing in their duty to the people and to the profession when they do not consider game an integral part of the forest and give proper recognition to it in the plans of management.

Wildlife is very rapidly increasing in importance in the minds of our people. It is one of the popular subjects of the present time. This interest is found in sportsmen's clubs, Boy Scout organizations, nature study clubs, and individuals. Within the past year the President has designated a committee on wildlife restoration, having as its object the formulation of plans for the protection and

restoration of game animals and game, song, and insectivorous birds.

It is not my purpose to attempt to prove that wildlife as a forest product ranks above timber in importance. However, it has a far greater value than most people realize or perhaps are willing to admit. Statistics might be cited to show the economic importance of it, the value in meat pounds, the value of fur, the business created through the money spent by hunters for guns, ammunition, and equipment. The total amount in Pennsylvania is estimated at between 17 and 18 million dollars annually. The greatest value, however, of game birds and mammals lies not in their meat pounds, but in the temptation that the legitimate pursuit of them annually puts before millions of desk-weary clerks, merchants, and professional men, as well as field-weary farmers, to don their hunting clothes and to go out in pursuit of their favorite game. That there is an intense interest in hunting as a recreation is evidenced by the fact that hunters themselves are willing, through the payment of a $2 yearly license fee, to pay their own way.

The recreational use of forests, especially those publicly owned, has grown tremendously during the past few years, and it will continue to grow. Wildlife is naturally a very important feature of this form of use because it furnishes the inducement to hunters, nature lovers, and others to go to the woods. The great public interest in wildlife and recreation cannot help but have a decided effect upon the future attitude of foresters toward the practice of forestry. They will of necessity give more thought to the creatures of the woods. They will be required to take a broader view of the forest than, generally speaking, has been taken in the past. The problem which confronts them is how best to manage the forest to permit the production of a maximum game crop without affecting seriously maximum timber production. The greatest contribution of the foresters will be in so planning their silvicultural system that the interests of game will be served.

The backbone of any state-wide scheme of wildlife management is the forest. Wildlife is definitely a product of the forest. Woodlands provide homes and hiding places which enable our furred and feathered friends to exist. Many of our most sought-for game animals and game birds, and a majority of the song and insectivorous birds, spend practically their whole lives within the woodland shadows. Many field dwelling mammals and birds when beset by hunter, dog, or other enemy seek safety in flight to the nearest woodland, be it woodlot or mountain border.

Important as the forest is to wildlife in providing homes and protective cover, the food problem is the most vital consideration where all life is concerned. All wildlife is found in profusion only where vegetation is found in greatest abundance. Forested areas, with their over-stories of trees of diversified species, their under-stories of nuts, fruits, and berry-bearing shrubs, and bushes, furnish food in profusion for beast and bird.

Wildlife management is largely a problem of food supply and adequate cover. By cover is meant the various growth conditions necessary to meet the requirements of game with respect to hiding, sleeping, resting, nesting, and raising young. By food is meant an assortment of food producing plants which provide a variety of berries, nuts, and seeds during all seasons of the year. Practically all species of game require, or at least prefer, just as do humans, different kinds of foods to meet their needs and desires. They likewise require various types of growth within the limits of the area over which the species cruises. The us

f various types of cover is not merely matter of choice, but is essential.

We may have good game laws, an excellent refuge system, an efficient corps f highly trained protection officers, a ood yearly output from our game farms, ut if there is not satisfactory cover or lenty of food for game our efforts are n vain. Game will increase up to the mount of vailable food and no further, ther conditions, of course, being favorble. It is in the development of these rime requisites that we need the coperation and assistance of foresters. By heir knowledge of the trees and of reults from cuttings they are better fitted han anyone else to render valuable ervices.

There are two principal ways by which oresters can assist in improving the ood and cover conditions for game, hereby making possible the maintenance f a larger supply. The first is the reatment of the area to influence the inds and density of vegetation to favor ifferent varieties of wildlife. The other s the planting of trees, shrubs, and vines which provide an assortment of food.

Many forest areas in Pennsylvania are ow past the stage where they furnish rowse for deer and good cover for small ame. The crowns of the trees on many reas have closed, shading out the undertory of valuable tree species as well as he "forest weeds"—those species of hrubs considered worthless by the forster, yet so important as game food roducers. It seems advisable now, and t will be more so as the forests mature, o put a guiding hand in the struggle etween the different tree species in order o maintain the proper understory at east on part of each area. The treatment given probably will be altogether ontrary to good forestry principles; hat is, the recognized practice of growng the greatest amount of the best producing, most valuable trees in the shortest possible time. Some valuable timber no doubt will have to be sacrificed on many areas in order to provide coppice or sprout growth for deer browse and thick cover for other species. Some valuable timber will have to be sacrificed to permit the growth of the so-called "forest weeds." These forest weeds require sunlight for growth, otherwise they are quickly shaded out by large growth. Wherever possible a forest of varying age classes and mixed species should be encouraged. A mature, even-aged forest often is open as to its floor, carpeted only with pine needles or fallen leaves and offering little cover in which game may hide. The low shrubs and plant life on the forest floor are particularly necessary for providing insect life for the young of game birds and cover and food for most game birds and animals.

In the planting of so-called waste lands with conifers, game should be given consideration. Coniferous species, while small, make good cover but provide very little food. Game is going to suffer irretrievable losses if the planting of all openings and old abandoned fields is permitted. In all such plantings the areas should not be covered entirely with trees, but wide strips or patches should be left to grow up to the miscellaneous assortment of plants which furnish game food. If not already present, such plants should be provided. If the waste lands are entirely eliminated from the forest areas, there is very serious danger of an immediate reduction of important small game species. Most kinds of game do not travel long distances, consequently some waste land must be left in all areas.

It has been said: "The economic prosperity of a nation is highest when its resources are utilized in a manner that will yield the maximum satisfaction of human wants." It seems to me that this should apply to land use. If our people

are going to be better satisfied when their forest lands produce for them some timber and in addition a good supply of game as well as a place of recreation, then the lands should be managed accordingly. Even depressions do not lessen the desire of people for sport, if the sale of hunting licenses is a criterion. A steady increase in the sale of licenses has manifested itself in Pennsylvania during the depression years, with an all-time high mark for normal years set during 1934 with more than 565,000 resident and approximately 6000 non-resident licenses. (The final figures are not yet available.) There was a slightly higher number of licenses sold in 1931, but that was the year when anterless deer were declared legal game, resulting in an abnormal sale of licenses. There probably always will be a demand for as much game as the forests can produce.

There is an opportunity for public service open to the state that develops its forest and waste lands in conformance with the principle of highest land use, recognizing the distinction between tree development for wood volume alone and tree development to favor all uses of the forest. Participation in the development of the forest for the greatest good to all is not only a forester's privilege, it is his duty. That participation will have to consist of more than merely setting aside and helping to develop an area for a public camp ground or selecting a site for a picnic. It must include an active interest in the welfare of game birds and animals.

For the welfare of the forest and to safeguard the future of forestry, foresters should take the initiative in the matter of providing suitable conditions for game. Game management and forestry are not independent projects that differ in their objectives and necessitate different or conflicting procedure to attain their ends. The same forest areas can and should be made to serve both. The people will continue to demand that game be provided. If foresters do not take the lead in helping to bring this about, there is the possibility of an unfavorable reaction whereby the cause of forestry will suffer.

As a forester, I am naturally interested in timber production, and as an employee of the Pennsylvania Game Commission I am vitally interested in the welfare of wildlife. This interest, however, extends beyond the time when I became associated with the Pennsylvania Game Commission. I naturally, by reason of my position, get the confidential opinions of many persons interested primarily in wildlife. It would surprise you to know how some really intelligent persons are thinking. One of the most dangerous theories advanced for the betterment of wildlife is the burning of the forest. I hear this often, and just as often do I emphatically oppose it. To have such an opinion become widespread would be a calamity to forestry and to wildlife conservation. Unless foresters are going to do something to help offset such opinions, we can look for difficulties just as certain as are the changes of the seasons. One of the best ways of doing this is to provide for cuttings of a few acres here and there, where the timber is large, and letting people know that this has been done in the interest of wildlife conservation.

If those interested in sport and those interested in timber pull separately, there is danger of overselling the idea of one of the uses of the forest and having it kick back on us. In a combination of the uses there is a greater possibility of stability and greater opportunities for the general support of sportsmen, nature lovers, and others. It is granted that the cause of forestry never looked brighter than it does today. Through the medium of the various relief organizations it has

ad almost a mushroom growth during ne past eighteen months. However, we nust look ahead to the time when we no onger have the help of these agencies and o the time when public support must gain be depended upon. The greatest rganized body of supporters will be those interested in sports and other forms of outdoor recreation. If foresters give them consideration, valuable help can be expected. If foresters ignore their interests, they will look elsewhere for the help necessary to a continuance of the outdoor sport of their ancestors.

FIRE DAMAGE IN THE PONDEROSA PINE TYPE IN IDAHO

By CHAS. A. CONNAUGHTON

Intermountain Forest and Range Experiment Station

DAMAGE caused by all fires larger than one-quarter acre on National Forest land in the Intermountain Region must be appraised. Normally satisfactory appraisals are made with comparative ease, but during years of abnormally high fire hazard, when the area burned may reach thousands of acres, it is beyond the power of the established organization to make the field surveys incident to complete appraisal of damage on all fire areas. In lieu of these surveys estimation of fire damage is required, and reliable data are needed to develop a basis of sound judgment.

The investigation reported herein was undertaken to supply the information needed on fire damage which may occur during years of abnormal hazard in the ponderosa pine (*Pinus ponderosa*) forests of central Idaho. Data are presented on mortality in merchantable and reproduction stands as determined by a detailed survey, and on the delayed mortality particularly in merchantable stands, which was determined by examination of a series of semipermanent sample plots.

The Study

A 45,000-acre conflagration which swept across a portion of the Payette National Forest and adjacent lands during an unusually hazardous burning period in late August, 1931, was selected as a suitable area for the purpose of this study. Practically the entire burn was in what is commonly known as the pure ponderosa pine type, including a variety of age and condition classes such as virgin, young growth, and cut-over timber. In general, all inherent features of the area prior to the fire, including the stand of timber and topography, were charac teristic of most of the ponderosa pin timberlands in central Idaho.

To obtain a thoroughly reliable sampl and at the same time to facilitate regula tion of the work, 9,308 acres, or slightl more than 20 per cent of the entire fir area, were covered by a 10 per cen cruise. The line-plot method of cruising was employed, wherein ¼-acre plots spaced at intervals of 2½ chains o strips 10 chains apart were established. Detailed information pertinent to the various phases of fire damage was recorde for each plot. For convenience, the general ponderosa pine type was divide into three condition classes, as follows: (1) virgin stands, (2) cut-over stands from which the merchantable timber ha been removed 8 to 12 years prior to th fire, and (3) young growth stands, 40 t 60 years old, which had been establishe on clear-cut areas.

Coincident with the strip cruise, stan density or stocking was sampled by system similar to that described an designated by Haig (1) as the stocked quadrat method. The chief divergenc from the prescribed system was the main tenance of a standard sized samplin quadrat regardless of the age or condi tion of the stand. It was deemed ad visable to follow this procedure becaus the normal stocking in the stands bein cruised was unknown and, by holding t one standard sized sampling quadrat, comparative figure for all stands coul be obtained. A quadrat containing 24 square feet was taken at intervals of on chain along each cruise strip. If one liv ing tree was present within the quadra it was recorded as stocked; if one dea tree, obviously killed by fire, and n

ing tree was present, it was recorded as ocked prior to the fire; and if there as no evidence of either a living or ad tree, it was recorded as never having en stocked.

In spite of the fact that nearly one ar had elapsed between the date of the e and date of the survey, the damage tributed to fire had not run its full urse. It was certain that some of the ore severely injured trees would be able to recover and that losses from sect attacks would increase. To ascer-in the extent of the delayed mortality,) semipermanent sample plots, totaling l acres in area, were established on pical sites. The trees on all plots were umbered and their condition, including own and bole damage, was fully de-ribed. These plots were examined fol-wing the 1933 and 1934 growing sea-ns.

Results and Discussion

A brief preliminary review of general aracteristics of fire behavior on the ea which was studied is necessary to cilitate application of the data pre-nted and to afford a comprehensive ew of the nature of the fire involved. he characteristics of the fire were ascer-ined roughly by classifying the kind f fire which burned over each cruise lot established. The usual method of assification (2) involving three kinds f fires, namely, crown, surface, and ound fires, was used, the distinction etween surface and ground fires in this ise being that a surface fire was desig-ated as any fire that consumed the lit-r, duff, and crowns of shrubby vegeta-on and lesser reproduction, whereas a ound fire was considered as one which nsumed the litter and duff only.

It was found that 43 per cent of the rgin area, 23 per cent of the cut-over ea, and 21 per cent of the young growth area had been burned by a severe crown fire. Most of the remaining area was burned over by surface fires of varying intensities, ground fires being of practically no importance. Unburned patches within the boundaries of the fire area were relatively unimportant, there being less than one per cent of virgin area and four per cent of the cut-over and young growth areas in this category. These data readily indicate the severity of a fire which may result in the ponderosa pine type during periods of extreme fire hazard.

Reduction of Merchantable Volume

The most obvious form of damage caused by fire is the destruction of merchantable timber. If salvage following a fire is feasible, the destruction of merchantable timber is limited largely to volume actually consumed, but if immediate salvage is not feasible, as is generally the case in central Idaho, all fire-killed timber must be regarded as a total loss. Since very little salvage has been possible on the fire area on which this report is based, all fire-killed timber was considered as destroyed.

Data showing the condition of the stand following the fire and the original stand per acre are presented in Table 1. This table is self-explanatory except for the division designated as "doubtful." As the name implies, doubtful trees were those which were so badly injured by fire that it was questionable whether they could survive. The "doubtful" classification is necessarily somewhat arbitrary, but for the most part trees with less than 50 per cent of their crown in a green or living condition were so classified. In addition, trees were classified as "doubtful" regardless of crown injury if their boles were so severely burned that windfall was likely, or if at least 75 per cent of the cambium at their bases was killed.

It is shown in Table 1 that a significant portion of the stand was in a doubtful status approximately one year following the fire. The fate of these trees was uncertain; and in order to ascertain delayed mortality which could be attributed either directly or indirectly to fire, the series of semipermanent sample plots previously mentioned was established in moderately burned stands. Definite data on the mortality of both the doubtful trees and the trees originally classed as living have been yielded by these plots.

The greater share of the delayed mortality in the ponderosa pine was caused by insect attacks; in the case of Douglas fir (*Pseudotsuga taxifolia*) the greatest loss was caused by insects and damage to the tree roots. A comparison of mortality data for the years 1933 and 1934, as presented in Table 2, shows that the mortality in ponderosa pine classed both as living and as doubtful in 1932 decreased in 1934, indicating that the insect epidemic causing this mortality was short-lived. This information essentially substantiates studies of insect losses on fire areas made in California (3) (4).

In the case of Douglas fir the percen age of delayed mortality has been highe than in ponderosa pine in the tree classed both as doubtful and as living The greater delayed mortality in thi species is attributed largely to a facto which did not appear at the time th study plots were established, that is, th effect of fire on roots. Damage of thi particular kind is very inconspicuous i outward appearance, and for the mo part it is confined to Douglas fir for th following reasons: In contrast to pon derosa pine, Douglas fir has a mor superficial root system and, because th species occurs most extensively on th more humid, sheltered sites in fairl dense stands, there is usually a compara tively thick layer of duff on the groun beneath the tree crowns. This layer o duff burns with a slow and consumin fire which heats the soil to a considerabl depth and badly injures roots growin in this heated zone. Mortality caused b burning or heating of roots was delaye until a year or two after the fire becau the trees injured in this manner graduall

TABLE 1

PREFIRE AND POSTFIRE STAND PER ACRE, BY CLASSES AND CONDITION OF STAND ONE YEAR FOLLOWI THE FIRE

	Av. number of trees per acre over 10" d.b.h.			Av. volume per acre bd. ft.			Per cent of tot volume per acr		
	Pine	Fir	Total	Pine	Fir	Total	Pine	Fir	Tota
				Virgin					
Prefire stand	16.74	8.71	25.45	12,027	3,227	15,254	78.85	21.15	100.
Postfire stand									
Living	4.29	2.21	6.50	3,513	952	4,465	23.03	6.24	29.
Doubtful	1.66	.58	2.24	1,149	209	1,358	7.53	1.37	8.
Dead	10.79	5.92	16.71	7,365	2,066	9,431	48.29	13.54	61.
				Cut-over					
Prefire stand	7.35	4.01	11.36	1,219	665	1,884	64.70	35.30	100.
Postfire stand									
Living	2.13	.69	2.82	412	133	545	21.87	7.06	28.
Doubtful	.88	.36	1 24	148	68	216	7.86	3.61	11.
Dead	4.34	2.96	7.30	659	464	1,123	34.97	24 63	59.
				Young-growth					
Prefire stand	17.24	1.33	18.57	2,480	280	2,760	89.86	10.14	100.
Postfire stand									
Living	7.92	.62	8 54	1,186	148	1,334	42.97	5.36	48.
Doubtful	2.21	.05	2,26	293	6	299	10.62	.22	10.
Dead	7.11	.66	7.77	1,001	126	1,127	36.27	4 56	40.

akened and succumbed during periods drought.

Delayed mortality attributed either di- ctly or indirectly to fire significantly creased the total loss of merchantable nber. From this study it appears that volume of both doubtful and living nderosa pine trees, dying one year or ore following the fire, approximately ualed the volume of the "doubtful" es, thus making a loss in volume due fire equivalent to approximately 71 r cent of the original volume in the gin stand, 66 per cent in the cut-over nd, and 52 per cent in the young owth stand. In the Douglas fir the lume of the delayed mortality over the me period approximately equaled the lume of the "doubtful" trees plus per cent of the volume of the trees ich appeared to be living after the e, making a loss of 82 per cent of fir in the virgin stand, 88 per cent the cut-over stand, and 68 per cent the young growth stand. When se percentages are weighted on the sis of the proportion of each species in respective stands, the total loss in lume, both as a direct loss due to fire d delayed mortality for all species, s 73 per cent in the virgin stand, 74 r cent in the cut-over stand, and 54 r cent in the young growth stand.

These data are directly applicable to damage appraisals and it is recom- nded that in lieu of field surveys they given careful consideration. If ac- l fire damage surveys for appraisal rposes are made immediately or within one year following a fire and no study of delayed mortality is undertaken, it is recommended that all doubtful ponderosa pine trees should be regarded as dead as means of compensating for accelerated mortality in what appear to be healthy living trees. Similarly, all doubtful Douglas fir should be regarded as dead, and because of hidden damage in this species, it is necessary also to reduce the volume in apparently living trees by 40 per cent. Obviously, this method of accounting for mortality accelerated by fire is subject to many variations, but until further studies can be made it furnishes a tentative guide to aid in determining the extent of fire damage in central Idaho.

Reduction in Reproduction

The reduction in quantity of reproduction (trees 9.5 inches d.b.h. and under) immediately follows the loss of merchantable timber in importance where timber values are the chief concern. The damage to stands of reproduction on the areas covered by this survey was determined by ascertaining both the original stand and the percentage killed on each plot, compiling the data into weighted totals for each condition class. No attempt was made to conduct detailed transect or quadrat counts at the time of the survey.

The data presented in Table 3 show the extent of the destruction of reproduction, and yet the full gravity of the situation is not realized without considering the distribution of the surviving stand.

Table 2

DELAYED MORTALITY BY YEARS (BASED ON VOLUME IN BOARD FEET)

Species	Mortality in portion of stand classed as doubtful 1 year after the fire (per cent)			Mortality in portion of stand classed as living 1 year after the fire (per cent)		
	1933	1934	Total	1933	1934	Total
derosa pine	48.2	9.2	57.4	16.6	9.5	26.1
glas fir	79.0	7.5	86.5	18.9	26.1	45.0

This phase is covered more fully under a later heading, however, and is merely illustrated with an example at this point. In the virgin stand the reproduction was reduced to an average of 20 trees per acre. Actually no reproduction whatsoever survived on 58 per cent of the plots established, and a majority of the living trees were found on only 7 per cent of the plots. A similar condition existed on the cut-over land, but owing to the less severe fire on the young growth area, the surviving reproduction was found to be distributed somewhat more desirably.

Reduction in Stocking

The reduction of merchantable volume and reproduction have been presented, yet both are incomplete without a discussion of the distribution of the surviving stand or stocking. On the basis of 4,800 quadrats taken in the virgin stand, the stocking was found to be 60.4 per cent complete prior to the fire, and in the cut-over stand 2,960 quadrats revealed a stocking of 63.6 per cent before the fire. The stocking since the fire has been reduced to 9.4 per cent in the virgin stand and to 14.6 per cent in the cut-over stand. Unfortunately, an incomplete field record excludes the second-growth area from this phase of the discussion.

The above data compared with reduction in volume data previously presented illustrate that the reduction in stocking is more serious than the reduction in volume. In the virgin stand stocking was reduced 84 per cent and in the cut-ove stand the corresponding reduction wa 77 per cent, compared to a reduction i volume of 73 and 74 per cent, respectiv ly, in each of the two stands. Destructio of small trees below the limit of me chantability and concentration of th surviving stand on a few lightly burne areas account for the fact that there wa a greater reduction in stocking than i volume. From the silvicultural point o view the great reduction in stocking ind cates the extent of the reforestation whic will be required to restore this fire are to timber production.

Summary

A survey was conducted to determin the extent of tangible damage which wa caused by a fire burning during a perio of abnormally high risk in the pondero pine forests of central Idaho. Slight over 9,300 acres were covered by a 1 per cent cruise, using the lineplot metho of sampling. Delayed mortality follo ing the fire was determined by sem permanent plots.

It was found that only 29.3, 28.9, an 48.3 per cent of the merchantable volum in the virgin, cut-over, and young grow stands survived the fire in what was co sidered a living condition. In additio approximately 10 per cent of the volum in all stands was classed as in a "doub ful" condition one year following t fire. On the basis of data derived fro sample plots established to study delay mortality, it was found that the volum

Table 3

REDUCTION OF REPRODUCTION BY CONDITION CLASSES, ACRE BASIS (TREES 9.5" D.B.H. AND UNDER). ALL SPECIES

Condition class	Average number of trees	Average number of trees surviving	Average number of trees killed	Per cent killed
Virgin	159	20	139	87.5
Cut-over	229	33	196	85.6
Young growth	258	100	158	61.2

the delayed mortality approximately ıaled the volume of the "doubtful" es in the case of ponderosa pine. In case of Douglas fir, the volume of the ayed mortality equaled 40 per cent of volume of the trees classed as living addition to the "doubtful" trees.

The total loss in volume for both pon-rosa pine and Douglas fir, including delayed mortality, was 73, 74, and per cent, respectively, in the virgin, :-over, and young growth stands.

Reproduction stands were badly dam-ed by fire. On the virgin forest area, .5 per cent of the total stand of repro-ction was destroyed. Similar percent-es for the cut-over and young growth eas are 85.6 and 61.2 per cent, respec-ely.

Stocking or distribution of the stand s reduced relatively more than volume. ocking in the virgin stand was reduced per cent, and in the cut-over stand 77 r cent.

In conclusion, it may be said that two in methods of application of the data esented are possible. First, if a tim-r survey of a fire area exists, the fire damage data as ascertained from this study can be applied to it on a percentage basis and the best possible estimate of fire damage without an actual survey will be obtained. Secondly, if no timber surveys exist, representative temporary sample plots can be taken in sufficient number to yield an estimate of the timber stand prior to the fire and then the data presented herein can be applied to the resulting figures.

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PHOTOELECTRIC CELL MEASUREMENT OF CROWN CANOPY DENSITY

By WILLIAM G. MORRIS

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THERE is a need in many phases of forest administative and research work for some simple but accurate method of measuring the relative density of the crown canopy in different stands without resorting to human judgment. Experiments are often made to show the difference in climate, amount of windfall damage, number of seedlings, species of undergrowth, etc., in partially cut as compared with virgin stands, but in most cases there is no satisfactory expression of the difference in density of the two types of cover. With the recent application of selective logging the need for a quick and reliable measure of canopy density is greater in the Douglas fir region than ever before. Problems arise continually concerning, on the one hand, the degree of stand opening necessary to furnish sufficient light for seedling establishment, and on the other hand, the degree of opening that produces dangerous fire conditions by exposing the fresh slashings to undue sunshine and wind. Areas having an optimum combination of seedling establishment and fire weather conditions may be discovered, but in order to describe those areas completely and accurately so that their conditions may be duplicated elsewhere there must be some means of gauging the amount of canopy shading.

The photoelectric cell, which has been used commercially in many different ways during the past few years, provides a convenient, simple, and accurate means of measuring light. A metal disc, energized by light falling upon it, yields a weak electric current. The total quantity incident light is measured by attaching microammeter to the circuit. A pock size combination of the cell and me into a single unit called the Weston e posure meter has been developed f photographers. The sensitive disc shielded so that it receives light from solid angle of 60 degrees only. Gau readings show the average amount light energy per square foot reaching t meter from within that segment, wheth it be direct light from a candle, reflect light from a wall, or a combination both.[1]

If the exposure meter is pointed t ward a white wall so that its 60 degr angle of reception barely includes t entire wall and it receives illuminati from no other object, a certain amou of light will be registered on the gaug 160 units for example. Then, if a bla lattice or grid is placed over the wa to cover 50 per cent of its area, t meter will receive 50 per cent of t original light and accordingly will reg ter 80 units. Thus the amount of lig as reflected from a partly covered, u form surface compared with that fro the same surface when uncovered sho the relative area of the cover. Furth more, if several grids of different cov age are used, the relative area of t various grids will be indicated by me surements of the light reflected from t wall. By a similar procedure the relati area of the crown canopy branches, twi leaves, etc., projected on the imagina surface of the sky can be compared

[1]For the reader's information, the Weston exposure meter is calibrated in candles square foot with a range of 1 to 1000, and the relative sensitivity to the various wave leng or colors is about the same as that of the human eye. Neither of these items conce its use in measuring crown canopy density as described here.

e stand with that in another, or in e stand with conditions in the open.

To measure the relative area of the own canopy in two different stands the posure meter may be used as follows: int the cell toward the zenith (or at me other constant vertical angle and imuth) and record the light value reg- ered. As in any series of observations, adings should be taken from a suffi- ent number of points, either at arbi- ary intervals or at chosen locations, to tain representative averages for the two ands in question. It is better if beams direct sunlight do not fall on the ce of the exposure meter. The object to measure the degree of coverage by e crown canopy, and the method de- ribed here accomplishes that end by easuring the relative amount of light flected from the sky through the multi- de of small holes in the crown canopy. e occasional addition of direct sun- ght, multiplying the magnitude of the ading many fold, is, therefore, merely unnecessary variable that decreases e consistency of the observations. Di- ct sunlight can be avoided by tipping e instrument slightly toward the north. e angle of inclination which is neces- ry will vary with latitude and time of ar, but 10 degrees from the vertical ould be sufficient in most cases. Mea- rements, to be comparable, must be ade at the same angle of inclination.

One procedure may be used in clear eather when it is desired merely to ex- ess the crown density of one stand as a rcentage of that in another. A second ocedure may be used in cloudy weather when it is desired to express the crown nsity of a stand as a percentage of full ening.

Procedure 1.—The sky should be clear. hite clouds are brighter than the clear y, and two readings will not be comparable if one is affected by a cloud while the other is not. Since the brightness in different parts of the clear sky varies with the angular distance from the sun, measurements in two stands should be made when the sun is in the same range of angular altitude. For example, they might be made from 10 a.m. to 11 a.m. in the first stand and from 1 p.m. to 2 p.m. in the second. In each case the sun will be the same distance from the zenith.

Procedure 2.—If readings under the timber are taken simultaneously with readings on the sky unobstructed by branches and are expressed as a percentage of the reading in the open, they will be comparable with any other readings expressed in this manner even though taken with different sky brightness resulting from clouds, smoke, position of the sun, etc. Any nearby opening giving an unobstructed view of the sky in a 60 degree solid segment will serve the purpose. If precise results are desired and the sky brightness is fluctuating rapidly in the segment to be measured, it will be necessary for two observers to make simultaneous readings in the forest and in the open. If less accuracy is desired or if the rate of change in sky brightness is small, a single observer may be able to make sufficient open sky measurements at intervals as he comes upon suitable openings during his measurements in the forest.

Side light is not a source of error in measuring sky brightness with this exposure meter, since light reception is limited to a 60 degree cone; neither is reflected light from tree trunks and branches or light transmitted through leaves an effective source of error, because it is too weak in comparison with the direct sky light. Therefore, when the instrument is pointed toward the crown canopy the only light of measurable significance is that from the sky overhead.

SAVING RESERVE AND SEED TREES FROM REDWOOD SLASH FIRES

By WILLIAM HALLIN

California Forest and Range Experiment Station

In the redwood region slash disposal presents a great problem. To obtain light on possible methods of controlling slash fires four specific fires were studied. The factors of control are analyzed and ways of utilizing them are pointed out.

IN the redwood region both the forester and the lumberman wish slash disposed of in some manner and degree, although usually not for the same reason. The forester desires disposal of slash because the debris left from cutting the heavy redwood stands, together with the great quantities of bark peeled before the logs are bucked, must be cleared up in some relatively harmless fashion if seedlings are to have a chance to establish themselves and both seedlings and remaining trees are to be protected from subsequent devastating fires. The timber operator burns his slash at the first favorable opportunity to avoid more disastrous fires later on and to clear the way for expeditious handling of the down timber. His slash fire, however, except under accidentally favorable conditions, is very costly in its destruction of seed trees and other reserved or "leave" trees, as well as of the organic layer. It even robs him of a portion of his profit in the damage done to down timber—damage variously estimated to be from 10 to 25 per cent of the volume of his cut. He continues to burn and to incur these losses because he believes that this practice, costly thought it may be, is the lesser evil.

The forester urges not only a modified slash-burning practice but also a partial or selective cutting instead of the present clear cutting of redwood, which involves the virtual wiping out of other species through destructive logging and burning He points out that regeneration by see trees is cheaper and more satisfactory th planting; that partial cutting, especial if combined with tractor logging, reduc breakage because of less crossing trees; that partial cutting makes it easi for the operator to control his output limiting his cut to the type of timb necessary to keep his yard stock proper balanced; that the smaller trees that t operator should be reserving actually f to pay for the cost of falling, buckin etc.; and lastly, that a selective cut gre ly reduces the quantity of slash to burned.

It is possible that the operator wou modify his slash-disposal practice, if n his method of cutting, if he could any effective and not too expensive w to do so. However, the high cost of moving the large quantity of debris other means makes some form of broa cast burning necessary. How is one control a slash fire which, if it is serve its purpose, must burn thorough a great mass of material?

Studies of Specific Fires

One way to answer this pertinent qu tion is to study slash fires, their effe and the factors that influence their havior. Such studies are under way the redwood region. A preliminary vestigation of slash fires was made duri

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[1]For a detailed discussion of the need for modification of the present burning policy "The rôle of fire in the redwoods" by E. Fritz. Jour. For. 29: 939-950.

fall of 1934. The objects of this ly were, first, to determine ways by ich some of the leave trees could be ed from the redwood slash fires, and, ondly, to provide a background for r, more intensive study. Following eral observations of slash disposal oughout the region, a detailed study s made of specific slash fires, but n as a preliminary study this was ch less intensive than was desired. In detailed study, only four actual fires e accessible for observation. An ex- imental burn that had been planned l mapped had to be given up because heavy rains.

Although these fires furnished some- at meager results, they were neverthe- s sufficiently characteristic of the slash es of the region to be illustrative of damage such fires do and of the ious factors that measure their de- uctive force. To that degree they point possibilities of control, through direct indirect control of these same factors. may be of interest to review the fires efly and to indicate some of the con- sions that are at least tentatively to drawn from them. The general char- eristics of the fires and the areas rned over are given in Table 1.

A general description of these fires l their effect is given in the following ragraphs.

Fire No. 1.—This fire, of average size a moderate slope, burned quite patchi- There were many small areas on ich the litter did not burn at all, and ers on which the fire was very hot l severe. As there are no data avail- le regarding the wind at the time of fire, definite conclusions cannot be wn, but the character of the burn licated a strong southeast wind. For mple, on one small area the crowns the trees had been completely killed, ereas the litter was unburned. The ly adjoining area on which a severe burn occurred was directly to the south- east, thus indicating that a southeast wind had blown the fire into the crowns of the trees on this area. Apparently, on the fire as a whole, the recent heavy rain had made the ground litter too wet to burn by itself, although the slash was dry enough to burn very well when fanned by a strong wind.

Damage to standing trees varied great- ly. Large trees still to be cut were not damaged appreciably. Smaller leave trees on the southeast slopes were quite severe- ly burned, but those on the other slopes suffered so little that they will still make satisfactory seed trees.

This fire indicates that, where other factors are also favorable, seed trees can be saved from slash fires if set after a heavy rain. It also indicates, however, that wet conditions alone may not insure a satisfactory survival of seed trees from fire.

Fire No. 2.—This fire covered a small area of moderate slope while fanned by a light wind. A fairly "good" burn oc- curred except around the edges, where in a few places the litter was not consumed. Nor were all the standing brush and chunks completely consumed. However, the burn was clean enough to eliminate the fire hazard and to facilitate logging. The crowns of the standing trees suf- fered very little if any damage. With few exceptions, even the lower parts of the crowns were free from scorching. This fire is of particular significance in that it indicates the importance of keep- ing the area of each burn to a minimum; in this case the damage was negligible and the area was only about 10 acres.

Fire No. 3.—This fire was a typical redwood slash fire, in which topography, timber, age of slash, method of burning, and size of fire were all characteristic of the redwood region. The wind remained generally in the same direction and at the same approximate velocity while the fire

TABLE 1

SPECIFIC OBSERVATIONS MADE ON 4 SLASH FIRES IN THE REDWOOD REGION, 1934

Detail	Fire No. 1	Fire No. 2	Fire No. 3	Fire No. 4
Date of fire	September 24	September 25	October 3	October 7
Date of examination	October 15	September 26 Observed from distance September 25	October 3, 4, 17	October 19
Area burned	40 to 60 acres	Approximately 10 acres	60 acres	75 to 80 acres
Exposure on burned area	Generally south, 2 draws break exposure into S.E. and S.W.	South of west	All exposures except east well represented	¾ W. or S. Remainder E. N.E.
Slope	15 to 45%	10 to 45%, average 30%	30 to 80%, average 50 to 60%	20 to 80%, m of area over 4
Topography	Lower and middle slope, 2 side draws and 1 side ridge through area	Very broad side ridge midway between main ridge top and creek. Also small side draws.	From creek bottom to ridge top, cut up by side draws and ridges.	Chiefly middl slope with cr bottom and lo slope along cr which runs through area. Cut up by s draws.
Timber type	Redwood	Redwood - Douglas fir. 30% Douglas fir, 70% Redwood	Redwood - Douglas fir. Chiefly redwood	Redwood-fir
Volume cut per acre	Approximately 100 M ft.	60 to 100 M ft.	Approximately 100 M ft.	60 to 80 M ft
Species left standing in cutting operation	Redwood	Redwood and Douglas fir	Chiefly white fir up to 40-inch d.b.h. Occasional redwood	Redwood, Doug fir, white fir, hemlock
Condition of stand when slash was burned	Portions partly chopped	Completely chopped	Portions partly chopped	Completely chopped
Age of slash	(?)	4 months	0-4 months	3-5 months
Time of day set	(?)	Noon	2:30-3:30 p.m.	Late morning at noon
Where fire was set	(?)	Apparently on lower side	Along lower edges and gulches running through area	(?)
Wind at time of burn	Strong S.E. (?)	Light N.E.	Approximately 3 mi./hr. N.W.	(?)
Precipitation previous to burn	Night of September 22 and morning of September 23 a very heavy rain occurred (first rain of season). Drizzle at intervals on September 24.		Clear weather from September 24 October 1. Rain night of October and morning of October 2. Clou morning of October 2 but clear afternoon. Clear morning of Octol 3 but vercast in p.m. Heavy r all day October 6.	

ed. Near the ground very strong and stantly shifting drafts were developed, ticularly on the north slopes. These e quite noticeable up to one-fourth e from the fire. The peak of the was reached between 5:30 and 6:00 ι.

)n a portion of the area with a north-t exposure, on which the timber was tially cut and the slash not over a nth old, considerable difficulty was ex-ienced in getting the fire started. Here ıard, clean burn was not attained and le damage was done to the crowns of standing trees. However, the burn satisfactorily clear the ground.

)n an adjoining south exposure, com-tely cut over, where the slash was ›ut one month old, a clean but not ere burn resulted. The crowns of the ›s were little damaged except those ler 50 feet in height. As the trees e were chiefly white fir, however, basal ıry may cause some of them to die ›r.

)n the remainder of the area, which › on both north and south slopes, the sh was dried out and from 1 to 4 nths old. A very hot fire occurred e, all the trees except redwood were ed, and the crowns of the redwood e destroyed. Although destruction of crown of a redwood tree does not kill tree, since the remaining limbs or the in trunk sprout again and produce a e column," it renders it unsatisfactory a seed tree, as a fire column will not duce seed for 5 or 10 years after the wn is burned.

'ire No. 4.—This fire occurred after vy rains in old slash and on some y steep slopes. On the north and theast slopes the fire was very moder-and patchy. In many places standing sh and chunks did not burn, and only lower portions of the crowns of some the trees were scorched. On the edge he chopping, where there were a great many trees still standing, the fire did not burn at all. On the north slopes the fire did not remove enough of the brush and chunks to be considered a completely satisfactory burn.

On the south and southwest slopes the fire was very hot and severe. The sever-est burn occurred in a long side gulch. Over all the southerly slopes it was, from the logger's standpoint, a good, clean burn. On the ridges and on moderate slopes only about half of the trees had as much as 25 per cent of the crowns still green. On the upper edge of the burn most of the trees were still living—here, however, the slope was much less steep than elsewhere. On the remainder of the area, all trees except redwoods were killed. Crowns of redwoods were destroyed. On this portion of the area the steep slopes—from 60 to 80 per cent—were an important cause of the severe burn.

Factors Affecting Slash Fire Damage

From the observations on these four fires and from general observations it is apparent that the severity of and the re-sulting damage from redwood slash fires is determined mainly by the interaction of four factors—moisture content of slash and litter, quantity and age of slash, wind, and degree of slope. These four factors are affected by two other impor-tant indirect factors—aspect and number of trees left standing.

Moisture Content

Moisture content of the slash and litter is the most important factor, because too much will prevent any burn and too little will result in a severe burn under any conditions. The moisture content at any one time is determined by the precipita-tion, the relative humidity, temperature, wind velocity, aspect, and number of trees left standing. The effect of precipitation

is self-evident and needs no discussion. Relative humidity affects the moisture content by the interchange of moisture between the air and the slash and litter. If the relative humidity is high the slash takes on moisture from the air, and if the relative humidity is low the slash gives off moisture. It is of considerable importance to bear in mind that the relative humidity is normally higher during the night than it is during the day. Temperature and wind both have much the same effect on moisture content of slash, in that evaporation increases as the temperature or wind velocity increases. Thus strong winds or high temperatures cause the slash to dry out faster. South slopes, because of higher temperatures, dry out faster and may have to be given different treatment from the rest of the area. This is particularly well illustrated by fire No. 4.

Standing trees, if present in sufficient numbers, have a very marked influence on the moisture content of slash and litter through their retardation of evaporation, caused by the lower temperatures, higher relative humidity, and lower wind velocity for which they are responsible. Standing trees have the same influence on later fires that they do on slash fires. This point is quite important, as subsequent fires are frequent in the redwood region. In a study made in the Northern Rocky Mountain Region, Jemison[2] found that on half-cut areas the fire hazard was very materially lower than on clear-cut areas. All the factors affecting moisture content were more favorable on half-cut areas: average duff moisture was 16.5 per cent and average branch wood (2 inch diameter) moisture was 9.5 as against 8.2 and 6.4 per cent, respectively, on clear-cut areas. The lowest duff moisture measured was 8.0 per cent on half-cut and 3.5 per cent on clear-cut areas. (the other hand, the average percenta of critical days, when duff moisture w below 10 per cent, was 32.3 per ce under half cover and 88.0 per cent fo lowing clear cutting. Some form selective cutting must be used in the re wood region, in order to leave enou trees to be effective in these respects.

Quantity and Age of Slash

The quantity and age of the slash c viously has a very definite effect on t intensity of slash fires, since type a amount of fuel are controlling factors any fire. The quantity of slash or deb is determined by the stand per acre, t number of trees cut or knocked dow the presence of peeled bark, and the de sity of brush. The number of trees c and the peeling of the logs in the woo are the only factors that can be co trolled for any given area. The age the slash affects the first factor, moistu content, since the greener the slash t greater the moisture content where otl conditions are constant. This is w illustrated by fire No. 3, where part the slash was less than a month old a part was 1 to 4 months old.

Wind and Slope

As is true on all fires, wind has a ve important effect on redwood slash fir and drafts caused by the fire itself of equal importance with natural wi The size of the fire and degree of slo gradient are the two items having an portant effect on drafts. The larger fire, the greater the volume of heat p duced. This large volume of heat connection with steep and cut-up top raphy produces drafts of high velocity, noted on fire No. 3. In addition to

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[2]Jemison, G. M., The significance of the effect of stand density upon weather beneath canopy. Jour. Forestry 32: 446-451, 1934.

ong drafts, the heat produced on large s has a very drying effect when blown the drafts over the unburned area. these reasons the larger the fire the ater the severity. A comparison of s 2 and 3 illustrates this very well.

The velocity of drafts increases as the ree of slope increases, as is shown by No. 4. The effect of a given slope be changed, however, by changing direction of the burn. A downhill is never as severe as an uphill fire.

As was indicated under moisture cont, slope aspect markedly affects slash es as southerly slopes dry out more ickly than the others.

Control of Slash Fires

How may such information as the ove be applied in regulating and ntrolling fires and so save leave trees l reproduction? The goal in slash rning is the least severe burn that will isfactorily remove a sufficient amount the debris for fire protection and the ablishment of reproduction. From the evious discussion it should be evident t there is a great variation in the facs affecting slash fires as well as in the sh fires themselves. The goal must reached by arranging or controlling factors of moisture content of slash l litter, wind, quantity and age of sh, and number of trees left standing, adapting the operation to them.

Employing Suitable Weather Conditions

The desired moisture content is the ximum that can be present in the slash hout preventing burning. This is te difficult to determine. For the sent, at least, it can best be deterned by the use of small test fires, and should be done separately for north l south exposures.

Of the six main conditions previously considered as affecting moisture content—precipitation, relative humidity, temperature, wind velocity, aspect, and trees left standing—the first four must be classed as weather factors. Weather can only be indirectly controlled by burning when suitable weather conditions prevail. It may be pointed out again that the normally higher relative humidity at night is important to consider in selecting the time of burn, as very often night burning is safe when day burning is not. Night burning on south exposures and day burning on other exposures may, for example, be used to balance a difference in moisture conditions. It is well to point out here that, except in very rare cases, moisture content is insufficient in the summer months to permit satisfactory burns in that season under any conditions.

Lessening Wind Influence

Natural winds can be indirectly controlled, apart from the effect of residual stand, by selecting the right method of burning. Slash should never be burned with the wind. Produced drafts also can be controlled by limiting the area burned at any one time and by burning downhill. Whenever conditions are such that a fire will burn directly downhill this method should be used, but because of cut-up topography, direct downhill burning may have to be combined with successive strip burning. The area burned may be limited by dividing the gross area into blocks with fire lines and setting each block at a different time, or by burning successive strips. In successive strip burning, a strip is burned off near the top of the hill or ridge; then as soon as the heat of the fire has lessened, another adjoining strip just below is burned, and so on until the whole area is completed. Ordinarily a slope can be completely burned in this way in 3 or 4 strips. However, on either blocks or

strips the size of each unit fire should be kept down to approximately 10 acres.

Partial Disposal

Partial disposal also may be used to keep down the size of the burn. This may take the form of spot-burning the areas of heaviest slash and greatest hazard, or of burning slash on strips and so blocking up the remaining slash into small units. In selective logging, where two or more cuts are made, a good form of partial disposal may be to burn all the slash from the first cut and leave that from the remaining cuts. The effectiveness of this method is still to be determined by actual trial. With any method of partial disposal, more intensive fire protection after logging is essential.

Keeping Down the Quantity of Slash

The quantity of slash can be altered by changing the peeling practice, as well as by limiting the number of trees cut or knocked over. If peeling is not done in the woods it will have to be done on the landing or at the mill. Complete peeling on the landing is not practical except when landings are large and some method of disposal of the bark is available. Peeling at the mill is the most desirable practice, but at present it is followed by only one mill. Wih special equipment at the mill to turn the logs, a complete job can be done; the bark can then be burned in the burner, or sold if a market is developed for it. As fast as operators can develop bark markets and mill machinery for peeling logs, the practice of peeling in the woods should be discontinued. Taking the logs into the landing or to the mill with the bark on eliminates one of the arguments for burning before yarding.

Increasing the Residual Stand

As has been shown, the number of trees left standing affects moisture co tent of slash and quantity of slash as we as modifying markedly the influence weather on slash disposal. Proper moi ture content can be attained by selectir the right time for a burn, even thoug no trees are left standing. Numerou standing trees, however, prevent sudde changes in the moisture content; and fo this reason, if standing trees are used i maintaining a sufficiently high moistu content, other factors can be controlle to much better advantage, and there is much longer period during which sati factory moisture content is present. Meth ods of cutting and logging, in turn, dete mine the number of trees left standin Selective cutting obviously leaves mo trees standing after chopping than do clear cutting. The advantages of sele tive cutting have already been discusse It is questionable whether many tre will be standing after any form of donke logging. However, by use of bull block and siwash trees, the number of tre left after high-lead logging may be i creased. With tractor logging, few any of the trees left standing after cho ping need be knocked down. The exte to which tractors can be used in the re wood region is not yet known, but the have already won for themselves definitely established place.

Conclusion and Summary

In view of the preceding observatio and discussion, the following recommen ations for improved practice in protecti reserve and seed trees, as well as see lings, from slash fires are tentative proposed:

1. Fires should only be burned whe there is adequate slash moisture conte as determined by test fires. Night bur ing should be employed freely, parti ularly on south slopes. Slash shou not be burned during June, July, a

gust or September, except in abnorlly wet seasons.

2. Fires should be set only in still ather or in light winds.

3. Each burn should be kept down to out 10 acres by dividing up the area h fire lines and burning it in separate cks, or by burning successive strips m the ridge top down, or by the use partial disposal plus increased fire tection. Direct downhill burning should used in conjunction with the above enever practical.

4. Adequate fire protection should be ovided at all times.

5. Slash should be pulled away from bases of residual trees where posle, to lessen basal damage.

6. Selective cutting wherein all or rly all trees up to approximately 40 hes d.b.h. are left uncut should be lowed wherever tractor logging or stic modification of the high-lead sys-n is practicable.

7. Burning should be done after yard-.

8. The bark should be removed at the landing or in the mill whenever practicable.

The above recommendations are not alternative. As many as possible should be used, and items 1 to 4 are essential in all cases.

Because of the important relationship between redwood slash disposal and residual trees, more intensive and detailed investigations are necessary. These investigations should be carried out along the following lines:

1. An intensive burning study should be made in which the recommendations given here and any other method which has promise are tried out experimentally under as many of the different conditions as possible. In this study, quantitative measurements should be taken of all the factors affecting the fire and of the damage done.

2. A study of the whole fire protection problem of the region should be made, with particular consideration to the relationship between slash and fire hazard.

3. Further investigations should be made on the use of redwood bark and on efficient methods of peeling logs at the landing or the mill.

WHITE PINE AND FIRE

By AUSTIN CARY

MR. MAISSUROW'S article in the April JOURNAL[1] on fire in relation to white pine reproduction greatly interested the writer. In the first place, it fell in with some of his earliest observations in the State of Maine and elsewhere; secondly, New England foresters have always had an extremely pointed interest in the tree named; third, a parallelism is suggested with other species. An idea brought into mind by the article is the large outlay that is now sometimes available to determine a silvicultural point. It was not so in the early days; for the most part men picked up information on these matters as a side issue while they went about other business. For the writer working conditions of that description long prevailed, so that what may be written on this topic will not be the result of accurate, purposeful study, but an account of general observation and experience, checked by other men, extension in respect to time and locality its chief claim to attention.

One of the earliest conclusions drawn from observations in the woods of northern Maine was that a large part at least of the pine timber of which we were possessed came to us through the agency of fire. That came out for one thing in connection with a great historic burn dating with the year 1825, a little less than 70 years previous to the date of first observation. White pine, white birch, and the poplars were the species characteristic of the second growth, but other species were mixed in, of slower development usually. Boundaries were perfectly plain; they were in fact mapped in a rough way, showing that this great fi swept over an area of 1,200 square mil approximately. At 70 years the bir was in its prime for utilization; much the poplar was overripe, had fallen was defective; the pine was being c rather extensively, and many ring coun and stem analyses were made. On o occasion, working on the borders of th great burn, I came across pine timb testing to ring count 10 years young This I felt sure was due to later fire, a inquiry proved the accuracy of the i ference.

This was, in the conditions of the tim young and low grade timber. The bu of the cut of the time was older by f but examination clearly indicated f much of it a similar origin. Even a was one indication; definite signs of fi in the shape of charcoal, charred stu etc., constituted another. These sig were so plain that really shrewd and o serving woodsmen without training forestry recognized them and had dra the same inferences. They concluded th a good share at least of our native pi timber came to us following fire. T timber surrounding the pine areas, wh we now call the climax type for the gion, was made up of red spruce w beech, maples, and yellow birch for t most part, species that reproduce und shade, distributed according to site co ditions. The extreme age for spru seemed to be about 400 years.

Following this Maine work, in the w ter of 1894-5 the writer had a further a illuminating experience, this time Michigan and Wisconsin. The job w

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[1]Maissurow, D. K. Fire as a necessary factor in the perpetuation of white pine. Jour of F
33: 373-378.

ng stem analyses of pine for Fer-
's Bureau. Here again the main facts
n stood out so clearly that only a
dull man could have failed to ap-
ıend them. The pine stands were
ı-aged as a rule; signs of old fire
frequently pretty plain, to say noth-
of recent ones. Much of the timber
untered was 200 to 250 years of
At that stage an undergrowth of
lock and hardwoods was general, and
ood many stems lay on the ground
ines that had been crowded out, cor-
onding with more or less opening in
crown cover. All this tended to con-
the conclusions already drawn in
ne, that fire in the woods was respon-
for much of the existing pine timber.

or did the above observations stand
e. A feature of the plan of work
to get at trees of as great a variety
ge as possible; and working with that
, two very noteworthy departures
the prevalent conditions were found.
was a stand just about 100 years of
—pure and very dense, without under-
th, reproduction when it occurred
ng in a year or two. The other was
dy of timber around 460 years of
some trees nearly 4 feet across the
p and around 150 feet tall, with a
deal of stump rot frequently. At
stage the stand had thinned out
edly; a good deal more had fallen
was standing yet; by this time the
er undergrowth of hemlock and
wood had grown up so that numer-
trees of log size were present. Either
or windfall was certainly the key to
conditions found; the former ap-
ed more likely in most instances.

en of today probably cannot realize
full of interest these early studies
The winter before, in Maine, it
been ascertained that our native
e was a tree of remarkable shade
rance, holding its vitality under
for a hundred years and more, at
the conclusion of that time coming ahead with the vigor of a young tree if opened. Here was demonstration that pine was of quite different behavior, requiring freedom to make a start, dependent for its perpetuation on a sharp break in the continuity of the forest. Nor did this demonstration stop where it was just left. Around the pine cuttings in some districts were areas that no one would think of except as mature hardwood and hemlock forest. This timber had no commercial value at the time and cutting was not carried on in it, but skirmishing around in this sort of territory one day I ran across a single old, decrepit pine, of large diameter and towering above the surrounding woods, with thin crown, and on its last legs evidently. There was no way to prove it, but the inference was strong that the stand about it was the end product of a course of events similar to that earlier depicted. That tree must have been the best part of 1,000 years old.

Mr. Maissurow goes off into one or two refinements where I cannot follow him, such as soil chemistry, while other matters, such as conditions making a desirable seed bed, have never been studied accurately. However, continued and extensive observation of the more common sort, resulting especially in broad comparisons, has its value as well.

New England experience, for instance, throws clear light on one point only imperfectly illustrated in the Quebec study—that old pastures and run-out fields seem to furnish an ideal seed bed for pine; and for spruce too, in spruce territory. Demonstrations of this can be seen all about, and in all stages; the heavy cut of pine box lumber of the section, maintained for 25 years or more, was derived mainly from abandoned farm lands. So clear is this succession that a Massachusetts lumberman proposed some years ago that in order to secure reproduction of pine the slash be

burned on cut-over lands, grass seed sown, and the area pastured. That has never been tried, so far as is now known; it seems as if with seed trees available it might work well; comparison is suggested with the plan of management developed on Harvard Forest.

The vital importance of the time relation between cuttings and the occurrence of seed years is a point that has come out repeatedly in New England forest practice, a point that has again been studied accurately by the managers of Harvard Forest. In that general connection, another has been brought to light by certain Maine farmers that conceivably may be made of wide use in the future. Observing that cattle do a good deal of browsing on hardwood shoots, they have in some cases turned cattle onto cut-over lots with result that in numerous cases have been most satisfactory.

With what degree of success windfall may replace fire as a promoter of the reproduction of white pine Mr. Maissurow does not seem to be entirely clear, nor can real assurance on this point be added by the writer, though impressions are on the favorable side.

On the upper Kennebec and Penobscot Rivers in Maine a very unusual state of timber affairs has been in existence for some years, interesting in itself, and throwing some light on the reproduction problem. Many years ago these lands were cut for their good pine, but more or less was passed by as defective, undersize, or in hard situations. Later the spruce that stood with it was hard pursued for our paper mills, while the market for pine stumpage fell off and shrunk in volume; in consequence considerable areas can be found today on which a good deal of pine yet stands, while the spruce and fir have been clean cut around it. On these areas there is considerable pine reproduction today. Mineral soil for reception of seed does not appear to be necessary, but freed[illegible] from hardwood reproduction or hea[illegible] shrub growth probably is, for it is [illegible] the softwood type of land that this [illegible] of facts has been noted.

Finally, reference may be made [illegible] general soil type in relation to pine [illegible] production and succession of speci[illegible] Here Harvard Forest may again be tak[illegible] as a starting point. When acquired [illegible] 1908 the stand of timber was very lar[illegible]ly pine, and no thought was in anybod[illegible] mind but that white pine would be [illegible] staple of production permanently on t[illegible] tract of forest. On trial, however, it v[illegible] found that pine, though it might be ma[illegible] to reproduce freely, would not co[illegible] through the competing species. It was [illegible] temporary type, following agricultu[illegible] and its abandonment, and on strong so[illegible] the natural factors all favored hardwoo[illegible] and finally the conclusion was reach[illegible] that these must be made the main obj[illegible] of management if the project was to [illegible] a practical success. Not, however, t[illegible] this conclusion was universal, for mi[illegible] areas, with different soil, grew pine nat[illegible]ally, and on these the original idea [illegible] adhered to. These principles are ill[illegible]trated elsewhere in New England, [illegible] various Massachusetts districts, and [illegible] same in southern New Hampshire and [illegible] Maine; on sandy tracts pine often [illegible]produces freely and shows every indi[illegible]tion of a power to hold the ground p[illegible]manently. In York County, Maine, [illegible] addition to areas of that description [illegible] other large areas of an intermediate ty[illegible] on which it appears as if there were [illegible] near balance between the two, so t[illegible] the scale might often be tipped either [illegible] by a little skillful management.

At the beginning of this, a compari[illegible] with other species was suggested; the [illegible] particularly in mind was longleaf pi[illegible] The area of distribution of this specie[illegible] enormous; sandy top soils are univer[illegible]

tever the nature of the subsoil; minor etation varies widely; in large part ıral stands are pure, but in a por- of its distribution other pines and iduous trees mix with it, while they quently show a strong tendency to ıe in as undergrowth. Fire has been re prevalent in this than any other erican forest type; this the tree resists re powerfully than any of its competi-. Observing these facts, there have n some of late years to assert not y that fire is a desirable feature in ıagement of this type of forest but without it the species would become nct.

Leaders of the JOURNAL and other rature are well aware of the above, of the arguments pro and con. These re is no intention of reviewing; in this will be confined to stating personal position on the points at issue. Fire, it is believed, will have a permanent and rather extensive place in the management of this type of forest; but the claim that without fire the species would disappear is thought to be extreme. Little doubt it would on some sites, the major and minor species and other conditions being as they exist; white pine in parallel conditions would do the same thing. But white pine, as has just been noted, maintains itself on certain other sites without the agency of fire, and in that respect too it is believed that when the facts are all in a similarity will again be found. This is stated as belief only, not demonstrated fact; but 17 seasons of familiarity with these woods, employed not primarily in observation, indeed, but in meeting practical situations as they arise, are behind the belief stated.

SCARIFICATION OF BLACK LOCUST SEED TO INCREASE AND HASTEN GERMINATION

By A. G. CHAPMAN

Central States Forest Experiment Station

The extensive planting of black locust in various parts of the country for erosion control requires the production of many millions of seedlings annually. A large proportion of black locust seed have impermeable coats which prevent or delay germination in the nursery beds. The recently increased use of this species has emphasized the importance of developing methods of seed treatment to obtain more prompt and complete germination. The following paper describes a mechanical scarifier for conditioning large quantities of seed rapidly and cheaply and sets forth the results obtained.

THERE are three methods of increasing and hastening the germination of black locust (*Robinia pseudo-acacia,* L.) seed in use at the present time—soaking in hot water, treatment with concentrated sulphuric acid, and scarification of the seed coats. Exposure of black locust seed to hot water has resulted generally in slight increases in germination. This has been confirmed recently by both Meek[1] and Meginnis (8). As early as 1898 Rostrup (10) used concentrated sulphuric acid (Sp. Gr. 1.84) to decompose partially the impermeable coats of *Lathyrus sylvestrus* seed, thereby increasing as well as hastening germination. Todaro (12), applying the acid treatment to seed of numerous legumes, secured favorable results. Love and Leighty (6) reported increased germination for seeds of red, sweet, alsike, Japan, and white clovers and alfalfa with the use of concentrated sulphuric acid as suggested by Dr. C. F. Hottis, Department of Botany, University of Illinois. Increased germination for seeds of *Acacia, Prosopis, Robinia, Gleditsia,* and *Gymnocladius* was obtained by Thornber (13) by use of concentrated sulphuric acid to which chromic acid was added. The solution was later neutralized and the seeds washed in running water. All these tests and many others have been made on small lots of seeds by numerous workers. More cently Meginnis (7) has worked out tails for the concentrated sulphuric treatment of black locust seed in la quantities, with considerable success.

Like the sulphuric acid method, more than a half century scarification been a means of rendering imperme seed coats of numerous species perme to water. However, until quite rece this has involved tedious hand meth such as cutting the seed coats wit knife or rubbing the seeds against st or sandpaper. Schneider-Orelli (11) ported good germination of seeds number of species of *Medicago* follo cutting or filing of the coats. A 1913, Professor H. D. Hughes, F Crops Department, Iowa State Col developed the "Ames Hulling and Sca ing Machines," which handled a bu of sweet clover seed per minute. Al and other small seeds of legumes also easily scarified. At present, agr tural implement companies are man turing many modifications of the scarifier, but almost without excep these machines break high percentage black locust and other large seeds, cannot readily be adjusted to do the properly. The "Barrel Seed Scari has been described by Hurst, Humpl and McKee (4) for use on seeds o

[1]In correspondence from Chas. R. Meek, Silviculturist, Division of Forest Management, D ment of Forests and Waters, Harrisburg, Pennsylvania.

umes, *Crotolaria*, *Lespedeza*, and *lilotus*. More recently these writers) have described the "Barrel and Disk ed Scarifiers" for use on the same ecies. Home-made barrel scarifiers are ported to be used effectively in some rseries on black locust seed, gravel or abrasive paper being the scarifying dium. F. P. Eshbaugh, state forest rseryman, Fort Hays Experiment Sta-n, Hays, Kansas, has reported to the iter a recently developed scarifier which rades seeds between two nested funnels, e rotating. As yet only small seeds ve been effectively scarified. Since the nnels are adjustable, Eshbaugh believes will effectively scarify tree seeds as ge as those of the Kentucky coffee e.

Impermeability of Seed Coats

Germination and swelling tests on black ust seed collected in various parts of Central States have revealed that ap-oximately 3 to 91 per cent of the seed ats may be impermeable to water, vary-g with different lots of seed (Table 1, umn 4). Seed which showed no swell-g in water at room temperature within days were considered to have impermeable seed coats. Actual seedbed tests demonstrated that there is a close relationship between swelling and germinative capacity. Impermeability was found to be due to suberized and cutinized secondary palisade cell walls, especially those at the outer ends of the cells adjacent to the cuticle. After investigating the seed coats of numerous species, including many legumes, White (14) concluded that: "As a general rule in small and medium sized seeds, the cuticle is well developed, and represents the impermeable part of the seed coat, while in the case of large seeds, such as those of *Adansonia Gregorii*, *Mucuna gigantea*, *Wistria Maideniana*, and *Guilandina Bonducella*, the cuticle is relatively unimportant and inconspicuous. In these seeds, the extreme resistance which they exhibit appears to be located in the palisade cells."

Contrary to a somewhat general belief, the heavy cuticle on the surface of black locust seed is permeable to water as shown by the absorption of a water solution of safranin in tests made by the writer. Therefore, any treatment of the coat to decrease impermeability must penetrate deeper than the cuticle. It is

Table 1

RESULTS OF SWELLING TESTS ON LOTS OF LOCUST SEED BEFORE AND AFTER SCARIFICATION

Seed source	Seed per pound	Loss by breakage at 2000 R.P.M.	Swelling test: Untreated seed	Swelling test: Whole scarified seed	Increase in swelling due to scarification
	Number	Approximate per cent	Per cent	Per cent	Per cent
Aurora, Ind.	24,480	0.1	11.5	89 0	77.1
Hillsboro, Ohio	16,329	5.0	87.4	99.2	11.8
Butler, Ohio	28,896	1.5	31.3	93.1	61.8
Minerva, Ohio	23,274	3 0	21.8	95.0	73.2
Milton, Ky.	26,284	1.5	47.8	97.1	49.3
Peekskill, N. Y.	20,160	3.0	24.0	98.1	74.1
Elizabethtown, Ill.	24,210	0.5	25.0	94.3	69.3
Southern Europe No. 1	21,420	0 5	50.6	91.2	40.6
Cottage Grove, Tenn.	18,450	2.5	32.4	90.7	58.3
Unknown (Katzenstein)	24,570	0.1	39.3	95.0	55.7
New Marion, Ind.	18,865	0.0	8.7	88.0	79.3
Kedron, Ill.	22,679	0 1	21.0	78.0	57.0
Southern Europe No. 2	23,580	0.1	23.5	85.0	61.5
Ames, Iowa	23,655	2.0	97.0	100.0	3.0

not definitely known why impermeability varies so widely among different lots of seed. Conditions of growths, degree of maturity of seed when gathered, methods of harvesting and storage, and inherent characteristics may be significant factors.

Mechanical Treatment

In the belief that mechanical treatment of black locust seed might prove highly satisfactory in instances where large quantities of seed are to be sown, methods of scarification of the seed coats to reduce their impermeability have been studied at the Central States Forest Experiment Station.

Use of the "barrel" type of seed scarifier has been suggested, but it does not effectively scarify lots of "hard coated" seed of black locust, as evidenced by a few users, and it is not adapted to rapid treatment of seed in large quantiti Various types of available machines signed to scarify seed of sweet clover a other small seeds of legumes were fou to damage black locust seed severe through breakage, often grinding them in meal. Further tests indicated that t Ames type of seed scarifier is readi adapted to modifications in design to pe mit of its use for effective and economic treatment of black locust seed. The wo that has been done to date and the resu achieved are explained herein for t benefit of nurserymen who need this similar equipment immediately. Furth experimentation will undoubtedly lead an even more efficient machine.

The Ames Scarifier

The Ames scarfying machine is simp in principle (Figure 1). Before a

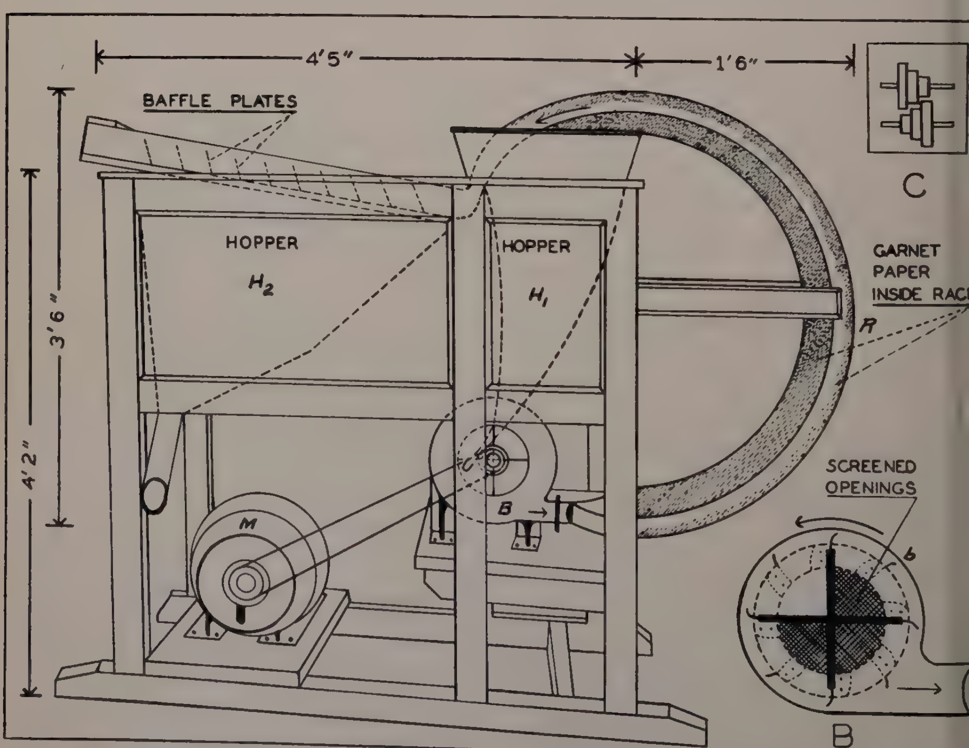


Fig. 1.—A diagrammatic representation of a remodeled Ames type of seed scarifier.

nges were made the scarifier damaged ck locust seed severely through break- . The principal changes were a con- of the fan speed; a closing of the side-openings with screen to prevent of seed; a reduction of the cross- ion of the seed race (originally 2 nes by 10 inches) to approach more rly that of the blower pipe; and the ering of both broad inner faces of race with an abrasive.

. forge blower (B) with a 12-inch is mounted on a platform near an ., single phase, one horse-power elec- motor (M) with a rating of 1,750 .M. for currents of 110-220 volts. h the motor and fan are equipped 1 a set of "three-speed intermediate leys" (c) arranged for varying the speed with one length of belt. The originally had 4 blades. To the end each original blade a broader blade heavy galvanized sheeting with for- d projecting flanges was riveted. A ch rim of the same metal was cut riveted to these flanges on either of the fan. This made it possible idd 4 extra short blades (b), midway veen the original blades, to produce reater air current and to give a more orm blasting of seed against the isive surfaces of the race. The blower rotates in a cast iron housing which a 4-inch opening on either side. With exception of a small space for the spout, these openings were closed fastening galvanized hardware cloth them with screws to prevent loss of flung by the fan. A semi-circular t race (R) with an inner cross-section 2 inches by 5½ inches is attached at lower end to the blower. Before the ction in the cross-section had been e the air current was insufficient to y the heavy black locust seed through machine. Both of the broad inner s of the race were surfaced with strips No. 3 Garnet Paper. This paper, 6 3 inches wide, may be purchased in rolls. By surfacing both of the broad inner faces of the seed race, scarification was considerably increased. Directly above the blower is a hopper (H_1) from which seed is fed into the race through the fan at a rate controlled by a slide. The seed is scarified by being blasted against the curved surfaces of the race by the fan blades and the air current, and is carried into a hopper (H_2) at the rear of the machine from which it is sacked.

Seed pass through a series of baffle plates at the end of the race before entering the second hopper. The plates are designed to clean the seed of light chaff, which passes out of the machine with the air current while the heavier seed are checked and drop into the hopper. However, most seed now on the market are well cleaned and do not require this feature.

The speed of the fan, controlled by the combination of pulleys used, should be varied between 1,700 and 2,200 R.P.M. for different lots of seed. Usually, the larger the seed the greater the ease of scarifying and the damage through breakage. Also, seed coats vary widely in their brittleness. The optimum speed may be determined by the operator on as little as a quarter of a pound of seed, and may be considered as the maximum rate which the coats can withstand with a minimum of breakage. Exceptionally tough coated seed require the maximum speed and may withstand a second treatment if necessary. Breakage is easily held to less than 2 per cent by proper control of the fan speed.

The cost of the machine is relatively low. Although the Ames scarifier is no longer on the market, used outfits for remodeling, excluding the motor, may be purchased for from $15 to $25 from county farm bureau agencies, high school departments of agriculture, or from other agencies or individuals who have discarded them for more modern equipment; or one may be easily constructed. Costs

involve those for new or used forge blower and electric motor, lumber for frame-work, 28-gauge or heavier galvanized sheeting for hoppers and seed race, and No. 3 or No. 3½ Garnet Paper. When this investment is prorated over a period of years and when large quantities of black locust seed are treated, the cost of scarification is low.

The rate of which seed can be scarified with this machine encourages more general treatment of seed in one-half ton or greater lots prior to sowing. Although size of seed and brittleness of seed coats may vary the rate somewhat, a bushel of seed can be scarified in approximately 5 minutes.

Results of Scarification

Tests on numerous lots of seed during the spring and summer of 1935 have shown that the percentage of germination of properly scarified seed is appreciably increased. Table 1 gives the percentage of swelling (approximate germinative capacity) for each of 14 lots of untreated and scarified seed. Samples of 250 seed of each were soaked in water for a period of 10 days. The treated seed was scarified at a fan speed of 2,000 R.P.M. In 10 of the 14 lots, given a single scarification, the final percentage of permeable seed coats ranged from 90 to 100. An examination of untreated seed from lot No. 14 showed abraded coats, probably effected during the threshing and cleaning processes. There is little advantage gained and oftentimes damage is done in trea ing such seed.

Figure 2 represents a portion of tl section of the Forest Service nursery Junction, Ill., devoted to black locu Excepting a small quantity, the se sown on July 9 in these beds were sca ified on July 6 and 8 with a modifi Ames scarifier. On the left in the fo ground is a check bed, sown also July 9 with untreated seed from the sa lot and at the same rate as the adjace beds. When photographed on Augu 15, twenty-five to forty times as ma seedlings per square foot were count in the beds sown with scarified seed in the check bed. In this latter, a lo rate of germination was still in progre on August 15. Similar results were o tained with different lots of seed at t Forest Service nursery at Ware, Ill., a in the Botanical Garden, Ohio State U versity.

Figure 3 shows the difference in ge mination of equal numbers of untreat and scarified black locust seed from t same lot. The seed sown in the left ha of the flat of sand were untreated, whi those seed sown in the right half receiv a single scarification. The seedlings we photographed 5 days after the seed we sown.

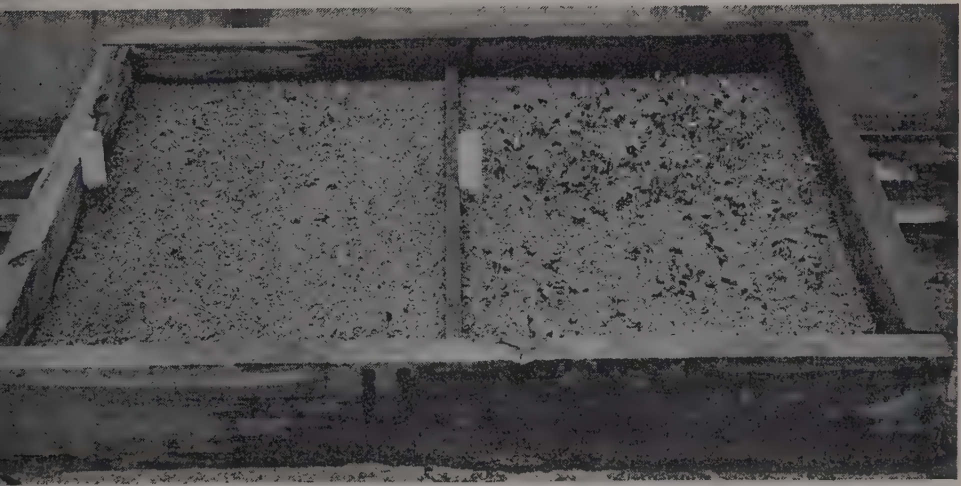
Scarification has been adversely cri cized by a few writers, possibly because limited experience with this method treatment. Ewart (1) believed that t process was too tedious and injured t seed. At that time he was justified in

Table 2

DESCRIPTIVE DATA FOR BLACK LOCUST PLOT SHOWN IN FIGURE 4

Source of seed	Permeable coats of untreated seed	Date of counting 1935	Treatment: None	Treatment: Scarified	Treatment: Aci treat
			Number of seedlings		
	Per cent		Row *a*	Row *b*	Row
Europe	23.5	July 30	250	646	44
		Aug. 24	297	773	36
			Row *d*	Row *e*	Row
Southern Illinois	21.0	July 30	127	644	40
		Aug. 24	178	636	36

g 2.—A portion of the Forest Service nursery at Junction, Ill., devoted to black locust. The d in the left foreground was sown with untreated seed. All other beds were sown with seed scarified with a modified Ames scarifier.



3.—A sand flat sown with black locust seed from one source. The seed in the left half untreated. The same quantity sown in the right half were scarified once. The seedlings were photographed 5 days after sowing.

first assumption. When working with red clover seed, Nelson (9) attributed broken seedlings from scarified seed to unequal pressure of the scarified coat upon the enlarging embryo. Hamly (3), working with alfalfa seed, warns of broken seedlings from scarified seed. These observations in no way hold true for seedlings from properly scarified black locust seed. It is recognized, however, that too much of any kind of treatment results in fewer seedlings.

No data are yet available to demonstrate the effect of scarification upon the duration of viability in stored black locust seed. Graber (2) found that after a few months the germination percentage of scarified alfalfa seed gradually decreased. A similar conclusion was reached by Hurst, Humphries, and McKee (5) after conducting tests on *Crotolaria*, *Lespedeza*, and *Melilotus*.

Comparison of Chemical and Mechanical Treatments

Of the various chemical or soaking treatments which have been suggested for reducing the impermeability of bl locust seed coats, a few have been u with considerable success. However, chemical method involves wetting seed and creates danger of injury to embryos through the process of swell and subsequent drying, by mechanical jury from handling in a swollen or s ened condition, by exposure of the bryos of seed having naturally permea coats to acid, by over-exposure of seed to the chemical, and by par hydrolysis of the seed coat, making seed more susceptible to fungus atta After treatment, careful drying and st age before sowing are essential to prev further loss.

The degree of damage to embryos fr exposure to concentrated sulphuric acid usually directly proportional to the p centage of permeable seed coats. Twen gram samples from lots of seed w percentages of permeable coats rang from 8 to 97 were treated with conc trated sulphuric acid (Sp. Gr. 1.84) 45 and 60 minute periods, respective an untreated check sample being set as for each lot of seed. For these leng

Fig. 4.—Black locust seedlings from seed of two sources—Europe, rows *a*, *b*, and *c*; and so ern Illinois, rows *d*, *e*, and *f*. Treatment of seed by rows—*a* and *d*, none; *b* and *e*, scarification; and *c* and *f*, acid-treated for one hour. Twenty-five grams of seed were sown each row on July 20. (See Table 2.)

treatment excellent results were ob-
ed for lots of seed with few permeable
s when seedbed conditions for ger-
tion were good, i. e., a warm, moist,
l-aerated soil. Digestion of the im-
meable coats by the acid was slow
ugh to prevent much direct exposure
he embryos during treatment. On the
er hand, lots of seed with naturally
1 percentage of permeable seed coats
e badly damaged with the above men-
ed exposure to acid. In a few in-
ces as high as 75 per cent of the
l was killed. Exposure of the em-
os to the acid occurred soon after
tment began. A pre-soaking test on
iven lot of seed should be a criterion
choosing the length of time to treat.

Jnder certain soil conditions it is diffi-
: to obtain a good stand of seedlings
n acid-treated seed because of fungus
cks. Germination tests on untreated,
l-treated, and scarified seed from
ious lots were conducted in both
enhouse and nursery plots. Without
ilizing the soil at high temperatures
without the use of fungicides, it was
remely difficult to obtain an even stand
seedlings from viable acid-treated seed.
nediately upon germination, and often-
es before, halos of fungi developed
ut the seed, destroying most of the
ng seedlings. Rows *a*, *b*, and *c* in
ure 4 represent, respectively, untreated,
rified, and one-hour acid-treated Eu-
ean seed. Rows *d*, *e*, and *f* represent
llings from similarly treated seed col-
ted in southern Illinois. The soil, a
dy clay loam, was thoroughly pulver-
l before drilling the seed. Uniform,
ular watering was practiced until the
llings were well established. A few
llings were still appearing during late
gust from the unscarified seed. Gaps
rows *c* and *f*, sown with acid-treated
d, apparently are due to destruction
fungi, as evidenced by masses of
celia developing at the time of germination, a condition not observed in the other rows. Severe losses of germinated acid-treated seed occurred in this and other plots during warm, rainy weather. Such rapid development of fungi is due largely to the available foods in the partially digested seed coats. It is believed that losses are greater in the more poorly aerated soils. Table 2, summarizing the information for the plot, shows fewest seedlings for the untreated seed and most for the scarified seed. It also may be noted that there was an appreciable increase in seedlings from untreated seed and a decrease in seedlings from acid-treated seed on August 24.

Summary

In view of the need for a mechanical method by which a more uniform and greater germination of large quantities of black locust seed could be effected, a study was made of the available seed scarifiers in the Central States. A number of machines were tested and found unsuitable for black locust seed because of their ineffectiveness, damage in seed breakage, or low output.

The Ames type of scarifier is easily modified to scarify black locust seed effectively and economically. A bushel of seed may be scarified in approximately 5 minutes. With the exception of the electric motor, the Ames scarifier may be purchased (second-hand) or built at a relatively low cost.

Germination and swelling tests on numerous lots of seed showed that the permeability of seed coats may be increased from as low as 8 per cent to 88 per cent in a single treatment. In most cases the percentage of seed coat permeability ranged between 90 and 100 after treatment.

The percentage of impermeable seed coats varies widely with different lots of black locust seed. Swelling tests should be run on any lot of seed before treating,

since over-exposure to concentrated sulphuric acid or too severe scarification lowers the germination percentage.

Under warm, wet soil conditions, loss in germinating scarified seed was less than that in germinating acid-treated seed under the same conditions as shown in numerous greenhouse and seedbed tests.

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BRIEFER ARTICLES AND NOTES

Howard R. Flint

[H]oward Flint, Regional Forest Inspec-
[tor,] Region One, of the U. S. Forest [Ser]vice, a member of the Society of [Am]erican Foresters since 1921, died of [pne]umonia in Missoula October 14, at [the] age of 53. He had fallen ill while [on] an exploration trip, the dangerous [and] spectacular character of which gave [it] wide publicity in the daily press of [the] country. The trip, down the Salmon [Riv]er, was successfully concluded, but it [cos]t Flint's life. He had gone on the ex[ped]ition, a joint undertaking of the U. S. [Geo]logical Survey and the National [Geo]graphic Society, as Forest Service [rep]resentative, though not in too good [phy]sical condition at the outset, and was [sev]erely ill when removed by airplane to [the] Missoula hospital, where he died the [foll]owing day.

[T]he Northern Region News, Region [On]e's house organ, said of Flint:

[“]He entered the Service as Assistant [Ran]ger on the Minnesota National Forest [in] 1910, was later transferred to the [Mic]higan National Forest, and then be[cam]e Forest Assistant on the Hayden Na[tion]al Forest, Wyoming. Shortly after [he] was assigned to the Wagon Wheel Gap [Exp]eriment Station, and thence to the [Ro]uneville National Forest. He left the [For]est Service in March, 1915, to be [sup]erintendent of a large tie manufactur[ing] company at Wind River, Wyoming.

[“]In June, 1917, he returned to the [For]est Service on the Flathead National [For]est and successively progressed through [the] positions of timber cruiser, lumber[man], Forest Supervisor, and Regional Forest Inspector. His latest assignment, which he was to have taken over upon the completion of the Salmon River trip, was in charge of game management in the Region.

“To all who knew him and to any who had any business dealings with him, will always remain the memory of his broad yet intensive knowledge of many phases of the natural sciences obtained through continual hard study and keen observation, his friendliness, his downright mental honesty, sincerity, and admirable courage, his painstaking thoroughness and application, his practicability and dependability, his intense loyalty to the organization, to his profession, to his duties and to his friends, his innate fineness, his high ideals and high character.”

Supplementing this, the Journal of Forestry gladly publishes the following appreciation contributed by Robert Marshall, Director of Forestry Office of Indian Affairs.

“I have just learned of the death of Howard R. Flint, who has been my ideal of what the perfect forester should be, just as he has been the ideal of dozens of other men who have worked with him during his twenty-five years of forestry service.

“Howard Flint had a great imagination. He could see the future implication of present activities. He could successfully execute new techniques while others were thinking of reasons why they were impractical. When others had caught up with him sufficiently to fight for the credit of what he had done, he was too busy going ahead on new frontiers to bother about the credit. Whenever airplanes are

used for forest mapping, timber appraisal, or fire fighting, they will be a vivid reminder of what Howard Flint's vision, through eleven years of pioneer effort, has done for forestry.

"Unlike most imaginative people, Howard Flint was also competent to a degree which few people ever attain. He had the ability of mastering the tedious, unromantic details through which imagination alone can be translated into practicality. But he did far more than merely master what he had to deal with. He was gifted with the tenacity and drive to carry through what he had mastered. He was absolutely tireless in his work, to which he devoted what would have been appalling hours were it not for his overwhelming love for forestry. This love for his profession, coupled with an iron constitution, made it possible for him to complete an amount of effective work which would have exhausted other people.

"Although he never had the opportunity of a formal technical training, Howard Flint probably had a broader acquaintanceship with the fundamental sciences underlying forestry than any man in the northern Rockies. This rare ability was sufficiently recognized among his fellow scientists that he was elected as president of the Northwest Scientific Association. Whenever, during the three years that I was with the Northern Rocky Mountain Forest Experiment Station, we wanted advice from the regional office on some piece of research, it was to Howard Flint that we went first. At every one of the three annual Regional research conferences which I attended, the value of the ideas which he contributed to the discussion stood out above those of anyone else in attendance.

"Howard Flint was versatile. He could himself efficiently do anything from digging a post hole or shoeing a horse to analyzing a colloid or classifying a complex lichen. He was generally rated b
the field men of the northern Rockies
the best all-round inspector ever to w
in Region One. His inspections help
in everything which concerned a range
silviculture, grazing, fire control, ro
and trail construction, personnel relati
ships, forest economics.

"Howard Flint was an expert in
these fields, but more than that, he h
such an understanding nature that
could make his expert knowledge help
without being the tiniest bit concei
or officious. He could criticize a m
without engendering either antagonism
discouragement. He spent so many ye
in actually performing all types of f
estry work that he not only knew
limits of human efforts, but he also co
discriminate between the weak and
strong. The incompetent men and
slackers who occasionally slipped i
the Service fared badly with him, but
overwhelming majority of loyal fores
found in Howard Flint a man with a s
sitive appreciation of their efforts.

"Howard Flint was courageous.
never yielded on what he sincerely
lieved. He never kowtowed to a super
though it might cost him prestige
position. He loyally defended both
and ideas which he considered right
the expense of his own advancement.

"Howard Flint was completely ho
He saw people for what they were
not for the advantage they might b
him. He saw events for what they
and not for what he wished they m
prove.

"Howard Flint was a great man, no
the trivial sense that presidents and k
and millionaires are great, but in
sense that real imagination, real ac
plishment, real understanding, real c
age, and real honesty are glorious."

FOREST SERVICE REORGANIZED

reorganization of the Washington e of the U. S. Forest Service went into ct November 1. The eight former aches (recently renamed divisions) are iered into four major groups, desig-d National Forest Administration, e and Private Forestry Coöperation, ration and Information, and Research. d acquisition and all the activities in nection with Emergency Conservation k are set up as two additional units. A ganization of the ten Regional offices he Forest Service has also been made. he new set-up looks to a closer knit anization, and also to a more effective dling of the greatly expanded work the Service. The organization plan es more adequate provision for wild-management on the National Forests, eation, personnel management, and ain other functions.

arle H. Clapp was appointed Asso-e Chief of the Forest Service, E. A. rman Assistant Chief and Adviser to Chief, and Earl W. Loveridge as As-nt Chief on Mr. Silcox's staff. R. F. nmatt will serve as Assistant to the ef. A Division of Fiscal Control, led by H. I. Loving, is directly at-ed to the office of the Chief of the est Service as an independent audit .

. M. Granger was named Assistant ef in charge of National Forests. Un-him are the Division of Fire Control Improvement, Timber Management, ge Management, Recreation and Lands, ineering, and a new Division of Wild Management. Earl W. Tinker will l the State and Private Forestry group, tive January 1, by transfer to Wash-on with the rank of Assistant Chief. group will include the Division of e Forest Purchase and Regulation, h will handle coöperation with state cies in the purchase and management land for State Forests contemplated under the recently enacted Fulmer bill; the Division of Forest Code, which is responsible for coöperation with industries and private timberland owners in promoting forest conservation; and the Division of State Coöperation, which coöperates with the states in organized fire protection and in production and distribution of trees for farm planting under the Clarke-McNary act of 1924.

Assistant Chief Earl W. Loveridge was assigned as acting head of the Operation and Information group, including the Divisions of Operation, Information and Publication, and Personnel Management. Acting in charge of Research is R. E. Marsh, with the Divisions of Silvics, Forest Economics, Range Research, and Forest Products under him.

Assistant Chief L. F. Kneipp was placed in charge of Land Acquisition, a unit which will handle land planning activities in conjunction with the program for purchase of lands for National Forest purposes. Fred W. Morrell, as Assistant Chief in charge of Emergency Conservation Work, will have under his direction all Forest Service activities in connection with the Civilian Conservation Corps, including allocation of camps and planning and supervision of work projects.

This new plan of organization will be further explained and commented upon in a later issue of the JOURNAL.

CROWN MAPPING SIMPLIFIED BY THE USE OF AN ABNEY LEVEL AND A MIRROR

Crown maps are used in forest research work when the expansion of tree crowns is to be studied or shade conditions on sample plots are to be shown graphically. They are made by charting the outline of the vertical projection of the crown of each tree in the stand.

After points perpendicularly below the edge of the crown of a tree have been accurately located, the charting of the vertical projection of the crown is a sim-

ple job of mapping. These points can be only approximately located by eye, since the upward sweep of ascending branches, the angle of drooping ones, and the slope of the ground surface cause optical illusions hard to overcome.

They can be accurately determined, however, if a plumb bob is used. One method is to suspend the bob from the top of a pole so that it may be held above the operator's head. The operator then moves about under the tree until the bob, the place where its string is tied to the pole, and the edge of the crown are in line. His eye is then directly beneath the edge of the crown. Many other methods involving use of the plumb bob are possible, but all are more or less awkward, time-consuming, and tiring.

Recently, while crown maps were being made on permanent sample plots of the Appalachian Forest Experiment Station, the instrument was devised. It consisted of an Abney level attached to a wooden block which projected past the front of the Abney and held a mirror at an angle of 45° with the horizontal plane through the line of sight. The mirror measured 2 by 3 inches and was fitted into a groove in the block at its lower edge, while the head of a screw overlapped its upper edge.

When the bubble tube of the Abney is locked at zero and the instrument is held level, any object seen reflected in the mirror, directly behind the cross hair, is vertically above the mirror at the point where the line of sight intersects it. The accuracy of the instrument was tested by suspending a plumb bob from a high support. The operator with the instrument moved about under the bob until, with the instrument level, the image of the bob was behind the cross hair, when it was found that the image of the bob lined up exactly with the image of its support. This method was used to make sure that the instrument stayed in adjustment.

With a little practice, points at edge of a tree crown were very speec located as follows: The operator selec a point at the edge of the crown fixed it in his mind by noting so peculiarity of leaf arrangement, the pr ence of a dead twig, or other distingui ing mark. He caught the image of point in the mirror and then leve the instrument. The direction in wh the image in the mirror moved d ing this leveling indicated the di tion he must move to come directly der the point. Usually only one or t trials were necessary. The vertical p jection of the point on the ground w of course, 4 or 5 inches in front of operator's feet, its exact position be the lower end of a vertical line drop from the image in the mirror.

Two men using this instrument w plane table, alidade, and chain map in three days the crowns of 172 trees $1\frac{1}{2}$ acres of sample plots. This is the rate of $\frac{1}{2}$ acre or 57 trees per day

J. H. Buell,

Appalachian Forest Experiment Stati

Girdling for Seed Production

The need for seed to replenish rapi diminishing supplies of black ash Indian reservations in New York St suggested experiments to induce seed p duction. Experiments were made in middle of May, 1935, in girdling by th methods to determine the relative ef tiveness of this means of assisting s production.

The experiment was carried out in proximately one acre of second-gro hardwood stand which had followed cl cutting of white pine and hemlock ab 1905. The soil is a moist clay-loam a level site. The trees examined are experimental plots thinned in 1934 1935 to an average stand of 450 trees

TABLE 1

NUMBERS OF TREES PRODUCING AND NOT PRODUCING SEEDS

D.b.h.	Spiral girdled[1]		Band girdled[1]		Cut girdled		Not girdled	
In.	Seeds	None	Seeds	None	Seeds	None	Seeds	None
2	----	2	--	1	----	----	----	10
3	----	4	1[2]	3	2	1	3	10
4	----	2	----	2	2	4	----	4
5	----	2	----	3	1[3]		----	2

[1]All dead above point of girdling.
[2]Nearly dead.
[3]Bountiful seed production.

e acre, containing white ash, sugar aple, tulip poplar, cucumber, red elm, ack ash, and an occasional red oak, iite oak, beech, and hop hornbeam.

The methods of girdling were:

1. A spiral band of the bark and mbium, one-half inch in width, was moved from breast height to a point one ot from the ground, with three com-ete turns about the tree.
2. A circular band, one-half inch de, was removed at breast height.
3. A horizontal knife cut through e bark and cambium, made with a achete, encircled the tree at breast ight.

The trees were re-examined on Oc-ber 19. Results are shown in Table 1. In this experiment one-half of the cut-rdled trees produced seed, whereas only out of 29 trees *not* girdled bore seed. oservations on trees 6 inches and over nearby woodlots showed no seed pro-ction. Undoubtedly the band and iral girdling was too severe and the es died as a result thereof. Callus had rmed rapidly on the cut-girdled trees t had failed to appear on band and iral girdled trees.

These experiments should be continued th larger numbers of trees and a great-range in diameters in both thinned d unthinned plots, and with cuts at various distances from the ground in bands and spirals of narrower widths, to determine the most efficient method.

JAMES D. POND,
Assistant Extension Forester.

EFFECT OF ANNUAL BURNING ON THICKNESS OF BARK IN SECOND GROWTH LONGLEAF PINE STANDS AT MCNEILL, MISS.

Neglecting to consider thickness of bark in cruising second growth longleaf pine stands may result in a biased estimate, according to MacKinney.[1] His work at Lanes, South Carolina, showed that double bark thickness at breast height was reduced approximately 0.1 inch by four annual fires, regardless of diameter class. He measured 377 trees on a burned area, and 426 trees on an area unburned for 14 years. Based on measurements of 236 trees, the reduction was about 0.2 inch in all diameter classes as a result of an accidental fire following 14 years' protection. Other biological factors are known to influence the thickness of bark. Density of stand, aspect of the site, and sunlight affect bark. Exposure to the sun increases the thickness of bark, according to Douliot.[2]

[1]MacKinney, A. L. Some factors affecting the bark thickness of second-growth longleaf pine. r. For. 32:470-474.

[2]Douliot, H. Recherches sur le periderm. Annales des Sciences Naturelles, Ser. 7: 325-. 1889.

To check the effect of fire on bark thickness of longleaf pines in southern Mississippi, measurements were made at breast height with a bark borer at McNeill in June, 1934. One hundred trees were measured in each of 7 diameter classes and from each of 2 conditions, *unburned* for 10 years and *annually burned* for 10 years. Both stands were established and grew in previous years under conditions of annual or frequent periodic grass fires. The trees were from 15 to 20 years old at a point 6 inches above the ground.[3]

The bark was thicker on the trees in the unburned stand than on those in the anually burned stand by an average difference of 0.029 inches for all diameter classes measured, as indicated in Table 1.

On land unburned for 10 years, and for trees 2 to 8 inches in diameter, single bark thickness varied from about ¼ to ⅝ inch, being about ⅜ inch for : inch trees, ½ inch for 6-inch trees, an ⅝ inch for 8-inch trees. More exa figures are shown in the table. The odc are approximately 2 to 1 that the tru means of single bark thickness for eac diameter class do not vary from th figures shown for that class by more tha ± 0.01 inch. The figures showing exces of bark thickness on the unburned tree are considered highly significant for th 2, 3, 4, and 6-inch classes, but are nc significant for the 5, 7, and 8-inch classe The mean values for all diameter classe together are mathematically more precis The odds are over 1,000,000 to 1 tha these means are statistically correct t within ± 0.005 inch of (single) bar thickness. However, the figures are base on random samples of bark thickness fo each diameter class, not on a randor sample of the stand, and hence do nc

TABLE 1

EFFECT OF FIRE ON THICKNESS OF BARK IN SECOND GROWTH LONGLEAF PINE STANDS AT MCNEILL, MIS

Basis No. of trees[1]	Diameter class (inches)	Single bark thickness at breast height (inches): Unburned 10 years — Mean	S. E.[2]	Burned annually for 10 years — Mean	S. E.	Excess on unburned — Mean	S. E.
100	2	.272	±.006	.233	±.006	.039	±.008
100	3	.331	±.008	.301	±.006	.030	±.010
100	4	.398	±.009	.368	±.008	.030	±.012
100	5	.448	±.009	.436	±.010	.012	±.013
100	6	.516	±.009	.462	±.009	.054	±.013
100	7	.550	±.011	.530	±.010	.020	± 015
100	8	.616	±.011	.598	.±011	.018	±.016
700	2-8	.447	±.0005	.318	±.0006	.029	±.00078

[1]One hundred trees were measured from each diameter class under each condition, makin 1,400 trees in all.

[2]S. E.=standard error, or the standard deviation of a mean $= \frac{\sigma}{\sqrt{n}}$ for mean bar thickness, or $\sqrt{\frac{\sigma 1^2}{n} + \frac{\sigma 2^2}{n}}$ for mean excess of bark thickness.

[3]Total age can not be precisely stated for longleaf pine because the seedlings remain i the grass stage for varying periods of years not recorded by annual rings of growth. Pessir L. J. Annual ring formation in *Pinus Palustris* seedlings Am. Jour. Bot. 21 (9): 599-603. 193

ıly represent this or any other natural ınd as a whole. By taking the figures r mean excess of bark thickness by ameter classes on unburned land, and ighting them by percentage figures om the stand table, the figures can be rrected to represent a typical stand. ie mean excess of bark thickness comıted in this way for the unburned stand, at is, considering the actual distribuon of diameter classes, was 0.033 inch, 0.004 inch more than the table shows.

This difference of 0.033 inches single ickness, or 0.066 inches in double bark ickness, is comparable to MacKinney's ;ure of 0.1 inch. Apparently the 10 nual fires in Mississippi produced only o-thirds as much effect on the bark did the 4 annual fires in South Caroıa. Comparison of the basal area of e stand as computed with and without e indicated difference in bark thickness ows that neglecting this effect of fire bark thickness in computing cubic-foot lumes of peeled wood in second-growth ngleaf pine stands in southern Mississippi may cause errors up to 2½ per cent. Any pronounced differences in fire history known to exist between the basic plots for the volume table used and the fire history of the cruised area may be considered in allowing for differences in bark thickness. Yet for most estimates of wood volume this difference in bark can safely be neglected, because it is small and only one of numerous sources of error.

W. G. Wahlenberg,
Southern Forest Exp. Sta.

Slow Decay of Hemlock Bark

It is common knowledge that piles of brush and bark in a wood-lot quickly decay. This completes the cycle of the chemical elements which enter into the composition of trees. The decay process releases the elements for the next generation of trees. Due to the presence of the resistant tannins and corky elements

Fig. 1.—Hemlock bark piled in 1866-67.

in the bark of most trees, wood usually decays faster than bark.

Figure 1 is of interest, however, in that it shows the results of extremely slow decay of hemlock bark in northern New England. Although the top of the pile is softened and encrusted with moss and lichen, the lower strips are sound and apparently unchanged in spite of a lapse of 67 years since the bark was piled. The slash and stumps have totally disappeared from the area, which now carries a mixed forest of old trees.

The shape of the intact bark shows that the trees of this old cutting were large ones. The picture shows the moderate curl of the wide strips. The date and nature of the cutting is known through the memory of one of the lumbermen, J. J. Plamandon, who still lives at the age of 91 years. He helped strip and pile many cords of this bark for a Mr. Goodnow of Franconia, N. H., in the winter of 1866-67. For some reason, two piles were left when the others were taken from the lot.

This tract of woodland is located about 2 miles south of Franconia. It is now owned by Robert Peckett, of Sugar Hill, who keeps it as untouched forest park, broken only by trails and a camp site. The bark piles will therefore remain intact for many years to come, with a strong possibility that much of the bark will resist decay for another half-century at least, in spite of the humid conditions in the northeastern forests.

Charles J. Lyon,
Dartmouth College.

Growing Sandalwood in the Territory of Hawaii

The early trade in sandalwood between the Hawaiian Islands and China, which was at its height from 1810 to 1825, was supposed to have been the cause of the alleged extripation of this valuable tr on the islands of this Pacific Ocea group, which is now an integral part o the United States. To be sure, practicall all of the large trees were at that tim felled and packed on the backs of na tives to the shore, where they were loade onto sailing vessels for the Far Eas and young trees were destroyed so th the oppression of the chiefs in compellin the common people to slave for this con modity could not be extended to the descendants. Crops of taro and swe potatoes were left unattended, famin stalked in the land, and the Hawaiia nation was almost ruined by the gree of the chiefs. The harrassed commo people did their best to root out ever last sandalwood tree.

Their efforts, however, were not su cessful because at present writing, mo than one hundred years since the origin harvests, sandalwood trees are not u common on the largest islands of th Hawaiian group. Botanists have d scribed at least 7 different species whic are widespread throughout these island from a bush form which is found ne the sea to a wide-leaf species which grow at 8,000 feet on the fog-drenched slop of Haleakala, the greatest extinct volca in the world. The largest trees foun today on the island of Oahu are 35 fe high, with a diameter of 20 inches.

The native species of sandalwood i Hawaii are now on the increase, due t the protection against scorching fires an the attacks of grazing animals afford by the local Forest Service during th past 30 years. They are of very slo growth, however, and it takes at lea 50 years for the heartwood to rea marketable size. This heartwood, whi is yellowish brown with a very clos grained, hard, even texture, is the on portion of the tree which carries th delightful odor. The present uses for are for carving and for the distillati of fragrant oil for perfumery and me

e. The largest market for sandalwood New York, where the heartwood fetches much as $500 a ton. Taken pound pound it is, therefore, the most valu- e wood in the world.

With this point in mind, the Forest vice of the Territory of Hawaii under- k some years ago to determine the st methods of increasing the number growing trees in the Hawaiian group. is was not an easy task because in all evious attempts the young seedlings ased to grow after 1 years, and died the nurseries after reaching 6 inches height. Studies of the root system of e sandalwood confirmed the common owledge that it is a root parasite, and periments were started in supplying the ung seedlings with hosts. A success- l system has now been worked out and s been adopted on a large scale.

When the sandalwood seedling is from to 7 months old it is transplanted into individual container, which is usually rejected pineapple can with a 4-inch ameter. At the time of transplanting few seeds of the ironwood (*Casuarina uisetifolia*) are sown in the container. e latter germinate and grow faster an the sandalwood, and are soon of fficient size to act as a host. The ndalwood roots attach themselves at veral contact points to the roots of the onwood by means of a tissue-penetrating ustoria, through which nourishment is sorbed from the host. When about one ar old from seed, the sandalwood trans- ant with its host, in the same soil con- ner, is carried to the final planting site d, with the least possible disturbance the roots of each, is carefully set in epared holes in the ground. Planting this method has attained 100 per cent ccess.

At first, seed of the native Hawaiian ecies, largely *Santalum freycinetianum*, s used in our experiments, but it was und that most of this seed was imma- ture and would not even germinate. This was due, it is thought, to the premature dropping of the seed from the tree on account of a fungus which entered the pulp of the seed through punctures made by fruit flies.

Through correspondence with officers of the British Forest Service in India I was fortunate in securing a supply of selected seed of *Santalum album* from Mysore. These responded excellently to our new system in the nursery and it was possi- ble to set out on a dry ridge near Hono- lulu in January, 1933, an experimental grove of 1,700 trees of this species. In two and a half years from planting prac- tically every one of these trees is now from 6 to 7 feet high and flourishing.

A *Santalum album* tree planted in the Punahou School grounds in Honolulu be- gan to bear viable fruit at one year from planting. At 2 years, 9 months of age it was 14 feet high and 3 inches in di- ameter. From this tree over 2,000 seeds have already been obtained for nursery use, and the plantings of this promising tree are being extended throughout the Territory. The trees in the large grove will soon be in bearing, and then there will be no limit to the amount of seed available.

We shall be aided in extending our groves of sandalwood by the birds which are fond of the pulp around the small seeds, but we shall have to wait many years before the heartwood is of suffi- cient size for the market. If we are able to keep out the spike disease on sandal- wood, which is rampant in India, our forester descendants will have the plea- sure and honor of reaping a large rev- enue from the valuable heartwood of these trees, and Hawaii will once more be famous—even more famous than for- merly—for its sweet-scented sandalwood trees.

C. S. Judd,
Territorial Forester, Hawaii.

REVIEWS

An Illustrated Manual of Pacific Coast Trees. By Howard E. McMinn and Evelyn Maino. *Pp. 409, Fig. 415. Flexible cover. Univ. of Calif. Press. Berkeley, California. 1935. $3.50.*

Foresters of the Pacific Coast states and British Columbia will be glad to learn of the above new manual of the introduced and native trees of this large region. For what forester has not had difficulty in identifying the strange trees brought from other countries and planted so profusely on streets, lawns, and fields of the far western states? Dr. McMinn is Professor of Botany at Mills College, Oakland, California. He prepared the text, while Miss Maino did the drawings. In the appendix is a list of trees by Professor H. W. Shepherd of the University of California landscape design department, arranged according to effects they will produce and according to their requirements.

The general plan of the manual is as follows: An introductory chapter with paragraphs on nomenclature, plant parts, and explanation of terms, is followed by a key to the genera based mainly on leaf forms and arrangements. The bulk of the book is devoted to the tree descriptions—first for the genera, then for each of the species considered. Scientific and common names, origin of the tree, description of the foliage, fruit, flowers and trunk, and of specific peculiarities are set forth briefly. Linecuts depict leaf, flower, and fruit characters, but for the palms, half-tone illustrations of entire trees are used. A rather complete glossary of terms follows the part on tree descriptions.

With upwards of 1,000 trees introduced to the Pacific Coast states for ornamenta shade, windbreak, and other uses, th region has become a vast arboretu Some of the introductions are of striki beauty, others bring variety to a loc natural deficiency of species, and othe will grow on sites too dry for the nati trees. The eucalypts, deodars, camphor pepper trees, araucarias, and some othe are exceedingly important elements present-day Pacific Coast landscapes. A of the 1,000 introduced are not commo some are quite rare, but 400 of them a common enough to warrant space in t manual.

The one objection of any importan that foresters will take to McMinn's tre ment is his alherence to the nomenclatu adopted by the commercial horticulturis While this will be appreciated by tho tree lovers who usually learn their tre from nursery catalogs, it does not he to iron out the confusion still existi The author does, however, give in m cases the synonyms known to foresters.

The reviewer, for one, would not without a copy. It will save him ma an embarrassing moment when he is ask to identify an exotic tree that is not f quently met with.

EMANUEL FRITZ,
University of California.

Barrtradens Vattved (Wetwood Conifers). By Forsten Lagerbe *Svenska Skogsvardsforeningens T skrift 2:177-264, 1935.*

Another valued technical work in f estry has been contributed by Dr. Lag

g, of Sweden, who is well known to through his technical studies, partic- ırly those on sap stains. The work on etwood" is a timely contribution to the owledge of a defect which has received le notice in this country, but which vertheless is present in our coniferous nds. In western coniferous forests a nilar high moisture content of the heart- od of certain species is known locally "watercore."

In Sweden, wetwood has long been cognized as a defect in pine and spruce the northern forest regions extending om upper Delecarlia. It has also been ınd in Norway and northern Finland. vo types of wetwood are recognized; e one in the upper trunk is always ınd in association with dead branch ıbs or knots, and the one in the lower ınk is associated with dead roots. Wet- od is recognized by areas in the heart- od with occasional sapwood areas owing unusually high moisture contents, rker color, brittleness, a tendency to g shake, and an increase in the water sorption properties. Seasoned wetwood sorbs water more readily than seasoned rmal wood. The depreciation due to s defect alone was found to run as high 15 per cent.

Winter-felled wetwood trees showed ooth, dark brown spots at the sawed ds of the logs in the areas where the isture content was abnormal. Lager- rg attributes the smooth surface to the eater hardness of the wetwood areas ere the water froze into solid ice. He ds that the high moisture content with responding low air content is respon- le for the large number of wetwood s which turn out to be "sinker" logs ring river driving. It was found to e a much longer time to season wet- od boards, and after seasoning these ards contained an unusually large num- of checks, which were responsible for erious amount of degrade.

As in the preliminary studies made in this country on "watercore," it was found by Lagerberg that decay fungi were not primarily responsible for the defect known as wetwood, although in some cases butt-rots and rootrots were found associated with the high moisture areas.

The source of moisture for root wetwood is through the dead roots, these roots having been killed by too much soil moisture or other causes, including fire injury. The entrance of water into the branch type of wetwood is through the heartwood of old dead branches, which absorb water through the deep longitudinal cracks and convey it along the branch heartwood into the heartwood of the trunk.

Slow-growing trees incapable of healing over the knots are found developing tubular fissues bounded by parenchyma strands which act as funnels for conducting water from the bark surface to the encased knots. Such trees are found to contain much wetwood. Lack of normal resin production also favors the absorption of water. In poorly stocked stands where pruning is incomplete the trees contain many low branches which later die and so pave the way for wetwood.

Lagerberg suggests that dense reproduction with early natural pruning should be attempted in an effort to reduce wetwood losses. Repeated thinnings would be necessary in order to accelerate growth, and he also suggests the mechanical pruning of older trees to encourage early healing of knot wounds. He concludes: "To a very large extent, the wetwood problem will no doubt be solved automatically, because with a rational treatment the stands will reach economic maturity before they have reached the age of beginning wetwood formation."

Ernest E. Hubert,
Pac. N. F. For. Exp. Sta., Portland, Ore.

Fifteenth Annual Report of the Forestry Commissioners for the Year Ending September 30th, 1934. *His Majesty's Stationery Office, London, 1935.*

The Fifteenth Annual Report of the Forestry Commissioners is of especial interest in that it reviews the activities of the Commission since its establishment 15 years ago, and also, more briefly, the situation on privately owned woodlands. The comparison between the program laid down in the Acland report and the actual accomplishment is clearly brought out, not only by figures and tables, but by two charts, one for acquisition of plantable land and the other for areas planted, that he who runs can read.

In a nutshell: The Acland program is in two parts, state and private owners. The state, in spite of heavily cut appropriations, has carried out 84.4 per cent of the land acquisition program, and has planted 54.6 per cent of the area of *new* coniferous forests called for. However, the total area planted, 250,200 acres, which includes 74,190 acres of replanting, is 77.8 per cent of the area to be planted under the Acland program.

The private owners were expected to replant the 478,100 acres cut during and immediately after the war, and were given generous subsidies. Actually they have planted only 174,720 acres including replanting, which amounts only to about 80,000 acres toward the deficit, or only about 17 per cent of their share of the forestry enterprise.

The accomplishment of the Forestry Commission is most creditable when it is considered that they had to build from the ground up, with few trained foresters and many new complicated problems to solve; then they were faced with a shortage of funds, due to the economic crisis. It must be remembered that the British method of meeting the depression was by cutting down government expenses, rath than, as in America, by increasing the The already high level of British tax precluded the lavish expenditures whi have been made for recovery in Americ even if such expenditures had be thought desirable, which some America are beginning to doubt, as they fores the inevitable day of reckoning ahead.

The revenue from the forests goes in the forestry fund, instead of into t Treasury as with us, and seems to act a stimulus toward efficient business ma agement. The revenue for the 15 yea amounted to the rather surprising su of $7,773,315 of which nearly half w received in the last 5 years. This is t yield from appropriations totaling $3 384,000, to which the revenue was adde and amounts to 19.9 per cent of the tot expenditure, or 24.8 per cent on t money appropriated by the government not bad for a government investme Part of this comes from re-sales of la and buildings not needed, and some revenue from the Crown Forests, whi were transferred to the Forestry Comm sion. On the other hand, there had r yet been any revenue from the plant tions, aside from leases of the shooti rights, and they will eventually produ handsome returns.

The principal cause of the failure private owners to carry out more than insignificant part of their share of program is the breaking up of the la estates. The Commission says (p. 1 "Under the economic conditions whi have obtained since the war, the sca are heavily weighted against private f estry and from present indications likely so to remain." The Commission on less sure ground when it says: "T difficulty is not peculiar to Great Brita In the United States failure to maint private forests has become so evid as to bring into disrepute the whole s tem of private ownership and exploi

" This overlooks fundamental differ-
s in the two situations, among which
the pioneer attitude in America which
rded the forests as inexhaustible, and
r factors responsible for the wasteful
of natural resources, factors which are
giving way to sounder conditions,
h will no doubt eventually result in
onsiderable development of forestry
er private ownership in America.

arket conditions in Great Britain have
very unsatisfactory, owing chiefly to
small scattered tracts of forest which
lt in irregular, undependable supplies
in poor selling methods. Some own-
sell by the block, getting a low price
unit, thereby causing confusion and
essing the market. Attempts to cor-
this by better organization have re-
ed in setting up the Home-grown Tim-
Marketing Association, with headquar-
in London and branches in various
s of England and Wales. The devel-
ent of this movement was most in-
tive to watch. It was slow, but
dy, starting from the bottom with
ough discussions among forest own-
and gradually crystallizing into plans
h were then further discussed and
ked over before adoption. The out-
e is a sound structure rather than a
ied scheme drafted from above and
ded down, looking well on paper but
loping fatal defects in practice. The
ervative, deliberate attitude which
luced it is similar to that found in
England, so well exemplified by
like Austin Cary.

here is now in course of formation
ational Home-grown Timber Council,
propaganda, economics, statistics,
e information, and a limited amount
esearch in forest products. It will
engage in commercial transactions,
will be made up of representatives
he Forestry Commission, the Forest
lucts Laboratory, timber growers and timber merchants, both English and Scottish, and users of timber, e.g., an architect, a railway official, a representative of the coal mines, and a representative of the building trades. As illustrating government aid to industry, the Forestry Commission is providing toward the expenses \$37,500 over a three-year period, on condition that the other interests contribute a mere \$1,500. It realizes the difficulty of financing an organization of this kind at the start, and expects that at the end of three years the disparity in contributions will disappear.

A brief account is given of the Commission's research work, which, as would be expected, is directed mainly toward planting and related activities, including also the establishment of sample plots. A number of difficult problems are involved, especially in the poorly drained moors of the north.

In addition to the retrospect of the 15 years' work, which takes up a little more than half of the publication, there is the usual annual report with tables and figures covering the year's operations, compared with previous years. This gives much interesting information which can not be covered in the space of this review. One item, however, might be mentioned, the cost of planting, as it seems so high to us. The average cost per acre between 1919 and 1934 for labor and material, including preparation of the ground, fencing, plants, planting, replacement of failures, and weeding, was \$46.75 for England and Wales, \$48.73 for Scotland, and \$47.48 for Great Britain.

This shows clearly the difficult conditions encountered and reflects the conclusion of the Commission, as a result of experience, that methods which sacrifice efficiency to cheapness do not pay.

BARRINGTON MOORE,
Collaborator, U. S. Forest Service.

Grundlegung einer forstlichen Betriebslehre. Ein Lehrbuch für Theorie und Praxis. By Christof Wagner. *Julius Springer, Berlin, 1935. Price RM 20 (bound RM 21.50).*

Wagner's term, *forstliche Betriebslehre*, is difficult to translate into English. He means the technique of forestry operations, i.e., cutting systems. In his opinion this is the most important field for the future evolution of forestry, for all of the timber values produced in the forest are realized by cutting, and this at the same time determines future productivity. He distinguishes between *Wirtschaft*, the strategy, and *Betrieb*, the tactics or organized technique of carrying out the economic aims of management.

In this book, which, according to the author, deals with a field not hitherto covered in forestry literature, the factors influencing the layout (*Schlag*) and the form (*Hiebsart*) and chronological progress (*Hiebsgang*) of cuttings in the sustained yield forest are analyzed. This distinction between *Schlag*, or cutting *area*, and *Hieb*, the cutting operation itself, is important. Loose use of the two terms has led to serious confusion. Size, form, and arrangement of cutting areas, governed largely by technical considerations, can and should be systematized and decided upon at the start of forest management. Methods and sequence of cutting, determined mainly by biological and economic considerations should be flexible so as to suit local and temporary conditions. The big defect of the so-called "silvicultural systems" of the past is that they have almost entirely failed to prescribe definite systems of cutting areas, but have attempted to standardize *methods*, which should be left largely to the judgment of the forest manager.

Wagner's analysis deals with the *Schlaghochwald*, i.e., high-forest in which definite areas are, during the course of a rotation, cut over and regenerated. his opinion the selection forest should relegated to those areas which are ab lute selection forest sites—high mou tains, very poor sites, protection fore and possibly river bottoms. These occu only 10 per cent of the area of Germ forests. He considers the trend towa selection management of the other 90 p cent, which is so much advocated now days, as a backward step which, if take will put forestry back where it started 1 years ago.

At the same time, he asserts that t technique of forest operations has ma very little progress since the time Cotta, in that it has generally adhered relatively large cutting areas (Breitschla cut over in one or several operatio Even where smaller areas—narrow stri or groups—have been employed, suffici attention has not been given to the nec sity of insuring adequate protecti against adverse influences—wind, su frost, etc.—to the remaining old stand a to the new growth. These errors are sponsible for the fact that only 5 to per cent of German forests are reproduc naturally, in spite of the great exp diture of time and thought to obtain na ral regeneration.

As a result of his analysis, Wag concludes that the *Saumschlag* (bor cutting), advocated by him for ma years, best meets all of the technic ecological, and economic requirements a cutting system for all except absol selection forest sites. Instead of the or inal term, *Blendersaumschlag*, he sugg "free or continuous Saumschlag," beca cutting within the strip is not necessa the same as a selection cutting. In t system, cutting proceeds in narrow ov lapping strips, generally starting from north or northwest, in such a way t the new stand is established and brou through its critical early years under shelter of the old timber, which is moved gradually. The width of st

rate of removal of the old timber are ·ely flexible, depending on conditions he particular time and place. These › cutting should follow each other at › 3-year intervals—5 years is altogeth- oo long! It is desirable, also, to cut weaker stems first and leave the larg- ones until the last, for these will put more valuable increment, will be bet- seed-trees, and will be more windfirm the others. Improvement, protective, cultural cuttings (which may be ıped as "development" cuttings) dur- the first four-fifths of the rotation ıld also follow the principle of con- ity, i.e., there should be no sudden ıt changes in the ecological conditions the stand. This means that such cut- s should commence early, be light, be repeated 2 or 3 times in a decade. 10-year interval which began with tig's "Fachwerk" system and which dominated German forestry for 100 rs was a serious biological and tech- ıl error, according to Wagner, that been responsible for poor increment, of windfirmness, and the inability many instances to maintain mixed ıds.

lthough he steers clear of the eco- ıic field, for the most part, Wagner poses one economic rule which hitherto had little consideration in German stry, and which should be of interest American foresters, viz: Devote the ıimum energy and funds to the good best sites, for these will yield the ıtest returns for the effort and expense; poorer sites should largely be left to ıre.

'he author is emphatically of the opin- that the Oberforster (or *Betriebs- rer*) must be the key man in the con- t of forestry operations, and that re- nsible work in the forest should not entrusted to subordinates, as is done considerable extent under the *Revier- ter* system in northern Germany. The ıagement plan should prescribe a defi- nite system, and all available data from research and experience as to the probable results of specific silvicultural treatment under given conditions should be given to the manager so that he can choose intelligently, but he should have wide latitude in regard to the silvicultural phases of his work. He should, therefore, have thorough theoretical training, at a University, especially in the biological and economic aspects of forestry. Wagner deplores the fact that there has never been any uniform forestry training in Germany, with the result that foresters in different states hardly speak or understand the same technical language and that there are almost as many brands of German forestry as there are states. He advocates the taking over of all forestry education and research by the Reich, with 3 faculties instead of the present 6. He also proposes that a certificate of technical qualification (*Reichsbeföhigunsnachweis*) be required of every public and private forest practitioner.

Although Wagner's work may give the impression that German forestry of the last 150 years has been all wrong, this doubtless is far from his belief. His statements regarding the deficiencies of the past and the virtues of the *Saumschlag* may occasionally be a little too dogmatic, but, at any rate, one can find plenty of instances in German forests that seem to justify most of his criticisms. The book is not easy to read and is hard to digest all at once, but it contains a great deal of real meat that well deserves careful study.

W. N. SPARHAWK,
U. S. Forest Service.

The Pack Organizations Founded By Charles Lathrop Pack. *Pp. 14. 1935.*

No future history of the conservation movement in the United States will be

complete which fails to mention the far-reaching influence that the Packs, particularly Mr. Charles Lathrop Pack, have exerted upon the public's attitude and conception of forestry. Through their various channels of education and publicity the Pack organizations have made forests and trees of interest to perhaps millions of Americans, children especially. Consider, for example, the four million copies of *The Forestry Primmer* printed and distributed to schools and other outlets in the United States, and the well known *Forestry News Digest,* with its average circulation of 55,000 copies per issue.

Mr. Pack's work of public education was begun as early as the administration of President Theodore Roosevelt. In this anonymous brochure Mr. Pack's part in the conservation movement is briefly traced from his presidency of the American Forestry Association onward through his founding of the various organizations that he set up to bring about a better understanding of the social and economic values of forests and wildlife.

Among the conservation activities that Mr. Charles Lathrop Pack and his son, Arthur Newton Pack, fostered should be mentioned the organization in 1922 of the American Tree Association; the creation of the Pack demonstration forests in New York State and Washington; their cooperation in 1927 with the Tropical Plant Research Foundation; and in 1930 the incorporation of the Charles Lathrop Pack Forestry Foundation. The Pack Forest Education Board, which up tc 1935 had awarded more than 30 fellow-ships to student foresters, was set up ir 1929.

The American Nature Association, anc its organ, *Nature Magazine,* came intc existence the same year that the American Tree Association was founded. This organization has had a somewhat broader mission than the former body; its program has been to stimulate public interest in nature and the conservation of all forms of wild life as well as of forests.

Those technical foresters who at various times have smiled upon some of the Pack organizations' activities, such as for example, the George Washington Memorial Tree Planting Campaign in 1932 will find from a reading of this concise and modest publication that Mr. Pack realized years ago something that some professional foresters today still fail to understand—namely, "the importance of public edcation as the basis of all conservation progress."

In short, the Packs have dramatized and popularized trees and forestry in a manner both extensive and direct. It is not too much to say that there hardly exists another agency in the land, either governmental or private, that could have done the same job and done it one-half so well.

Henry E. Clepper,
Pennsylvania Department of
Forests and Waters

CORRESPONDENCE

The following personal letter to the Executive Secretary of the Society is published with the permission of its writer.

October 23, 1935.

DEAR FRANKLIN:

You will be somewhat surprised to learn that Mr. Simmons, Commissioner of the Department of Conservation, has granted me a three months' leave of absence to accept a position with the Resettlement Administration in the Regional Office at Champaign, Illinois.

As I understand it I am to have charge of the project development work of the resettlement areas of the Land Use Division, in the five states of Indiana, Ohio, Illinois, Missouri, and Iowa.

It is with great reluctance that I am leaving Indiana, but the Resettlement Administration have offered me a very broad and interesting piece of work to do.

Mr. Hershel A. Woods will be Acting State Forester until I decide whether or not I am to keep my position permanently with the Resettlement Administration.

Before making this move I satisfied myself that the technical work and the forestry work in Indiana will go forward without any interruption. There are technical foresters in the office and on the state program as well as in the ECW work.

Although Mr. Woods is not a technically trained forester he is completely in accord and sympathy with the technical side of the forestry program, and has assured the technical men in the field and in the office that he is to be champion of their interests and rights and of a high standard of technical and ethical forestry work under his administration. For the past several months he has been requesting me personally to add several more foresters to the program.

Mr. V. M. Simmons, Commissioner of the Department of Conservation, has been a wonderful Commissioner as far as the Division of Forestry and the technical men in this office have been concerned. He has given us a real opportunity for forestry in Indiana during his administration. You can rest assured that things will continue on a high standard of technical administration as long as he is Commissioner of the Department.

Before leaving Indiana, counsel with good friends in the Forest Service and in the forestry profession advised me that it would be perfectly ethical and all right to leave my position to accept another one with the Resettlement Administration. It took a long time to decide that this was the correct thing to do. But, after thinking the matter through and taking counsel with some of the outstanding men in the forestry profession, a decision was reached to progress to a broader field.

During my service since March, 1926, in Indiana it has been a privilege to see the classified forests, or private forest lands listed for permanent forest production in the state, increase from about 139 to 1400, or an increase in acreage from about 13,000 acres to something like 114,000 acres.

The state forests have been increased from 1 of 3,500 acres to 10 of approximately 42,000 acres. Within the next month or so approximately 10,000 more acres of stripped-over coal lands will be added as state forests, and the Resettlement Administration is acquiring 40,000 acres of land which they propose to turn over to the state for state forests.

The United States Forest Service has been invited into the state and they ex-

pect to acquire within a zone of approximately 800,000 acres the net total of about 500,000 acres for National Forests. The state forests have been developed under the ECW program with roads, trails, fire lanes, forest plantings, and recreational facilities.

The research work established on such a firm basis by former State Forester Deam has been expanded until there are experimental forest plantings and other projects on nearly all of the state properties. We have coöperated to the fullest extent with the Central States Forest Experiment Station and the United States Forest Service.

The forest fire protection program has been extended from 1 obsolete tower, which was here in 1926, to 20 at the present time. There are roughly 1,500,000 acres of state and private lands under the first stages of forest fire protection at the present time. There are 2 technically trained foresters in the field now as district foresters promoting this work.

The ECW camps have planted some 35 or 40 million trees. Approximately 30 million trees have been grown for the camps and the WPA program to plant this fall and next spring.

Three state forest nurseries have been established and during the past several years some 16 or 18 million trees have been grown and distributed by these nurseries to private owners and planted on the state forests, parks, and game preserves.

The appropriations for forestry have been increased accordingly. Only $13,000 was available the first fiscal year of 1926 for carrying on the forestry work. The budget for the past three or four years has been approximately $140,000 a year by including the receipts from state forests and $10,000 from the Clarke-McNary nursery and fire protection funds. The budget for the present year will run some $168,000 or $170,000.

The strong support Commissioner Simmons has given the Division of Forestry during his administration in the past two years is largely responsible for the large budget this year for carrying on the program. He has allowed about $90,000 for land acquisition to increase the area of the state forests.

The School of Forestry has been strengthened and expanded by Purdue University. Ninety freshmen registered in the forestry course this fall. An Extension Forester has been employed by the Agricultural Extension Service at Purdue University and they are increasing his staff by employing an assistant forester to assist him in the wood-lot and farm extension program.

On the whole it looks as though the establishment of a good, substantial forestry program in Indiana is well on the way and has become so strong that I do not think that it can ever be upset. The only trend it can possibly have will be forward.

In leaving Indiana I want to assure you that I am not losing my contact either with the Forest Service or with the state forestry organization or with the Society of American Foresters.

I want to thank you personally for the interest you have always taken in Indiana and look forward to seeing you whenever you are in our territory or coming through Champaign, Illinois.

In closing be assured that your contacts with Mr. Woods, Acting State Forester, will be both pleasant and such as to indicate that the work in Indiana will go forward under new management. A great many new ideas helpful to the work and to the profession as a whole will undoubtedly be the result.

Sincerely yours,

RALPH W. WILCOX,

State Forester.

Editor, JOURNAL OF FORESTRY.

DEAR SIR:

Your editorial on "Wild Lands" in the November JOURNAL is extremely useful because it illuminates two conflicting phases of the recreational use of public forests. As in most questions there is truth on both sides. But there must be some basis upon which a decision can reasonably be arrived at on a question of administrative policy, some way of making an approximation of what constitutes right use. By "reasonably arrived at," I mean what would be the judgment of the majority of persons familiar with the problem and who are in position to recognize the public needs of any particular forest. The forest can serve no higher purpose than the public need; therefore, it would seem that this question pends entirely on the highest service to the largest number of our people. After all, every person has a vested interest in public forests.

It is quite obvious that it is not in the public interest to shut up all public forests as a wilderness, and it is also quite obvious that it would not be to the public interest to honeycomb such forests with paved roads, camps, trails, recreational facilities, and other foreign intrusions. So there should be a middle ground, which may be found largely through public need.

The need for so-called forest recreation has been increasing in this country in proportion to the increase in population, the progress of urban concentrations, and the development of conveniences in transportation. It is, therefore, quite natural that a tremendous demand should be manifest, particularly in thickly populated sections like the Northeast, for making available to all, in many forest areas, the pleasures peculiar to such environment. In fact, it would seem to be a government obligation to reveal a large proportion of these natural treasures and benefits to strong and weak; those in good health as well as those who need recuperation; the sturdy hikers and the physically incapacitated people; women as well as men, children as well as adults; and perhaps most important are the children.

In coming to a decision regarding the policy of handling the Adirondacks or any other State or National Forest or Park we must depend largely upon a consideration of the public need, which is shown in many very definite ways. The tendency has been and still is away from the wilderness idea. So we have had numerous problems of road, trail, and camp construction and the development of recreational facilities up for authorization from time to time, and generally they have been approved by the people and have demonstrated their justification.

The justification of the White Face highway can be appreciated if one watches the crowds who go there, as they gaze enraptured over that unexcelled natural panorama. In addition to bringing thousands of people into the woods who otherwise would not go, this highway, and forest highways generally, impart better appreciation of the beauties of forested areas. This helps to convey to the people the value of these resources. Trails and highways make for public education and better conservation. The Adirondacks and other forested areas mean little to those who have never seen them.

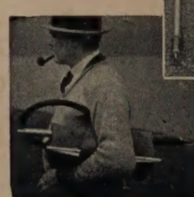
However, neither this movement nor the wilderness movement should go to extremes. The extent to which they should be established can only be determined by the judgment of those persons hereinbefore mentioned, based upon their knowledge of the public need.

GURTH WHIPPLE,
New York State College of Forestry.

"RANGER SPECIAL" WATER BAG

BECAUSE the "RANGER SPECIAL" Water Bag is a fairly recent development, erroneous ideas regarding its construction and design are held by some who have not tested or used the equipment. One objection raised by some prospective buyers appears to be that a fabric container will not last as long as one made of metal and will be more liable to puncture or cutting. Just the reverse has been proven by Rangers who formerly used metal tanks. They have found that the fabric bag lasts longer because of the absence of rigidity in its construction. When it is dropped or thrown the shock is absorbed. It is practically impossible to puncture the heavy treated duck and it cannot be attacked by rust or corrosion.

Fills quickly. Patented closing lock guarantees a dry back at all times.



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